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AGARD HIGHLIGHTS

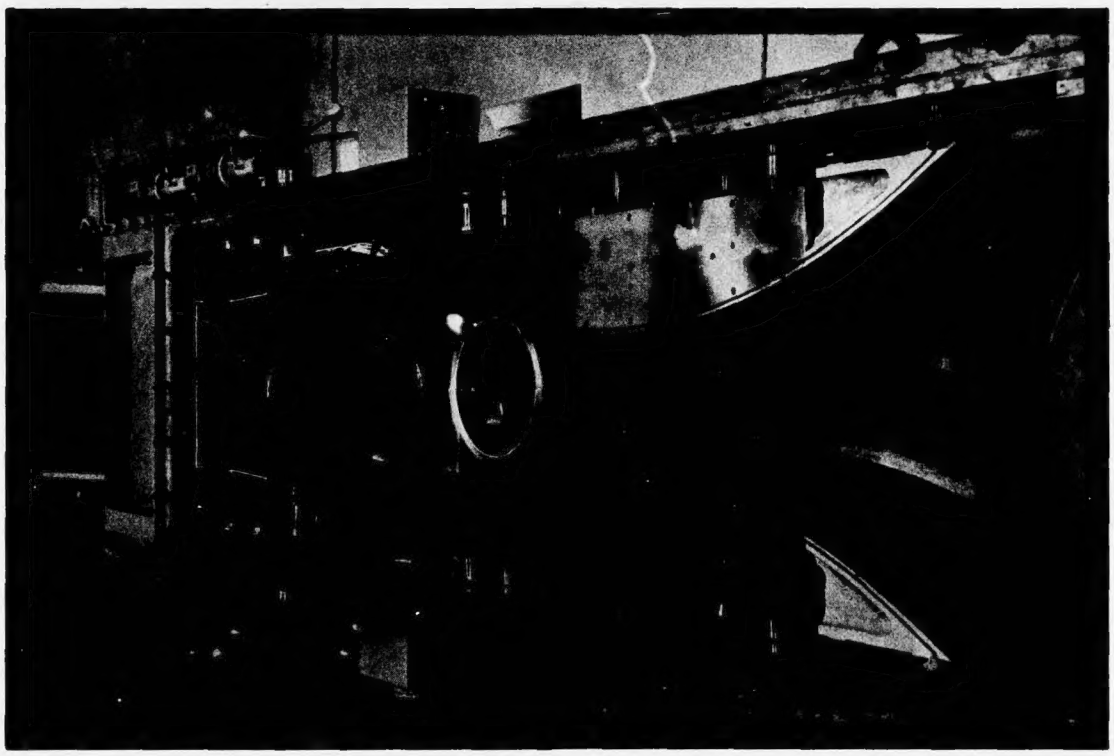
Advisory Group for Aerospace Research
and Development, Paris (France)

March 1976

AGARD

ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

HIGHLIGHTS



NORTH ATLANTIC TREATY ORGANIZATION

THE MISSION OF AGARD

The mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Exchanging of scientific and technical information;
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;
- Improving the co-operation among member nations in aerospace research and development;
- Providing scientific and technical advice and assistance to the North Atlantic Military Committee in the field of aerospace research and development;
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community.

The highest authority within AGARD is the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Program and the Aerospace Applications Studies Program. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one.

Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

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Partial contents

All members of AGARD, whether National Delegates, Panel Members or AGARD Staff, are cordially invited to submit articles likely to be of interest to other AGARD members for the next issue of *AGARD HIGHLIGHTS* which will appear in the Autumn of 1976. Articles should be addressed to:

Scientific Publications Executive
AGARD-NATO
7, rue Ancelle
92200 Neuilly sur Seine
France

or, from US and Canada only:

AGARD-NATO
APO New York 09777

The cover shows the Supersonic Wind Tunnel S-1 at the Von Kármán Institute for Fluid Dynamics, Rhode-St-Genèse, Belgium, which this year celebrates the 20th Anniversary of its foundation. This tunnel is a continuous closed circuit facility of the Ackaret type, driven by a 615 kW axial flow compressor, and has a 40 cm x 40 cm test section.

THREE YEARS OF CHANGING TIMES: AGARD DIRECTOR'S THREE YEAR REPORT 1973–1976

by Olav E.Blichner
Director, AGARD

The former AGARD Director, Dr Michael I. Yarymovych, in presenting his report to the AGARD National Delegates Board three years ago, referred to "Three Years of Advances". I have chosen to call my own report "Three Years of Changing Times", which should not be interpreted as indicating no advances over these years; on the contrary. Rather it places the emphasis on the fact that internationally we have experienced some rough times which have also been reflected in AGARD activities throughout this time period.

During the meeting of the AGARD National Delegates Board in Athens in September 1973, three main issues related to military R&D were taken up for discussion. They were as follows:

- Economy
- Energy
- Standardization

The issues were at the time discussed in the light of the existing general military, economic and political situation. A few months later, however, with the advent of the Middle East War and the following oil embargo, these issues were to take on quite a different dimension. In the ensuing years much of AGARD's work has been strongly influenced by the resulting change in the world situation, partly because much stronger technical and scientific emphasis has been placed on the three issues mentioned but mainly because of the more difficult economic climate AGARD has had to face in these years. An environment of rapidly increasing prices and wages together with military budget cuts has time and time again forced AGARD to reconsider its priorities, establish alternate plans, consider new ways of carrying out its activities and rationalize its work in an effort to maintain its technical-scientific level of effort. Realizing the voluntary nature of, and sometimes token remuneration for, much of the work carried out for AGARD, such measures always have to be undertaken with care lest one be faced with a negative reaction. Economically, therefore, one may well speak of a point of diminishing returns. Nevertheless, times of crises always have their special challenges and I am happy to report that they have been well countered by AGARD as a whole, in such a way that we indeed have managed to maintain our constant level of effort throughout the last three years. At the same time, we have managed to improve on our operations – our technical-scientific activities – as well as on AGARD Headquarters Administration.

Any new AGARD Chairman/Director team will start out on the foundations resulting from the accumulated work of previous teams. It is with the recognition of the indebtedness to these and most of all to the backbone of AGARD as represented by its Panels and AASC efforts under the guidance of the National Delegates Board, that I report on the progress made in the last three years.

BUDGETARY CONSIDERATIONS

The AGARD formal budget as recommended by the National Delegates Board and approved by the NATO Authorities, constitutes, as you are aware, only an estimated 10 per cent of the total AGARD effort. Nevertheless, this ten percent is vital in making it possible to draw on the resources which the member nations make directly available to AGARD. Therefore, it has become even more important to assure that a viable budgetary level be maintained in order to carry on with a constant technical-scientific level of effort, as desired by the National Delegates Board. It has been a continuing task to convince the NATO Authorities of the soundness and cost-effectiveness of AGARD efforts, and of the priority they merit within NATO activities.

Certainly in the economic situation experienced in these years, AGARD could not expect to escape the virtual reduction in financial allocations as experienced by other agencies. In fact, cuts in the NDB approved budget of up to 12 per cent have been experienced. I hasten to add, however, that these cuts have mainly been based on views that the maintenance of a constant level of effort would be possible within the allocated funds. With some adjustments, i.e. additional funding and rationalization of AGARD work together with changes in money values favourable to AGARD, we have indeed

been able to keep up our efforts, and thereby maintain and in some cases even increase our momentum.

Let me also add and emphasize that I have met with understanding and a spirit of cooperation at all levels within NATO Headquarters in my efforts to secure proper AGARD funding. This; I believe is a result of a better understanding of what AGARD is trying to do and a belief that the returns on AGARD efforts warrant the expeditures NATO is making in this field. It should also serve as an indication of the importance of AGARD keeping these authorities continuously informed about the overall impact of its activities, both directly to the Military authorities and more indirectly to industry and R&D laboratories.

PROGRAM ESTABLISHMENT AND EXECUTION

Having established a sound economic basis for its activities, the AGARD programs have been carried out in accordance with the guidance and directives of the National Delegates Board. In formulating the program, due consideration has been given to the military needs. in broad terms, of the NATO Community, in keeping with the AGARD requirement for quality and relevance. The principal changes from previous years' programs have taken form of redirection of efforts rather than spectacular turnabouts. It is apparent, though, that within their frames of operation, the Panels and the Aerospace Applications Studies Committee have made rapid responses to NDB requirements concerning the economy, energy and standardization issues. AGARD programs have been generally characterized by the gathering and exchanging of information already generated or in the process of being generated in the various countries. In several instances, AGARD has taken on projects in an attempt to plan and coordinate at the outset work to be carried out in various countries. Such ventures, termed "cooperative projects", have shown promise of great savings by all involved. The Panels have been strongly encouraged to expand on such activities in their establishment of new Working Groups.

In response to the NDB's emphasis on improved AGARD internal and external coordination, efforts have been undertaken to this end. Internally, on Executive as well as on Panel Chairmen level, programs have been initiated which ensure a two-year lead time for information exchange on tentative future activities. Externally, coordination is improved through increased AGARD participation in meetings of relevant NATO agencies. A position of AGARD Executive for Coordination and Liaison has been established, on a trial basis, whose task it will be to ensure that adequate information is available about activites within NATO related to AGARD fields of responsibility and also to establish the current status of aerospace activities within NATO countries.

Concerning meeting activities, AGARD will during my term have organized a total of 115 meetings. The number of Panel meetings, following an NDB suggestion was reduced to 65, while Lecture Series meetings were increased to 50 in response to requests from several countries. In addition to these meetings, many meetings of AGARD Working Groups and Sub-Committees have been held in conjunction with Panel Meetings at AGARD Headquarters and, when deemed necessary, separately in other countries. The number of Working Groups and Sub-Committees has varied between 43 and 27 during my tour, and at the end of my period will be about 30. These activities are very valuable tools which, together with the Consultant Program, give AGARD the capability of relatively short reaction time. As has previously been the case, the support for these meetings by the various countries was excellent, and I wish to take this opportunity to thank everyone here present and abroad for their keen efforts, and to let it be known that their work has been greatly appreciated.

Panels

In the course of these three years, I have made it a point to attend as many Panel meetings as possible. I have felt it necessary, and of great help in carrying out the responsibilities of the AGARD office, to have this direct contact. It has enabled me, on the one hand, to receive signals on the Panels' thoughts and ideas at an early date and, on the other hand, to convey to Panels information on NDB policies and on AGARD Headquarters administrative requirements. In addition, it has indeed been one of the great satisfactions associated with the Directorship of AGARD to be able personally to make friends with so many fine people.

Through my close association with the Panels, I have become impressed by the many able and dedicated people who are engaged in AGARD Panel activities. I have found these Panels to be very responsive to NDB requests, by employing their knowledge critically as specialists in their respective fields to recommend to the NDB proper lines of action.

As a result of our efforts to coordinate Panel activities, a larger range of tentative programming is being initiated by the Panels, thereby enhancing the cross-flow of information within AGARD. Referring once more to the issues of Economy, Energy and Standardization, the Panels have proved their ability to respond quickly, each according to its particular way of operation and method of attacking a problem. Through the flexible system of initiating activities, the Panels have, through short term consultant missions and new Working Groups, been able to react quickly; in the longer term, Specialists Meetings and Symposia have been planned to take place in the near future. This capability for differentiated response, together with the strong element of continuity which the Panels represent, truly make them the backbone of AGARD. It should be remembered that this flexibility and, therefore, ability to be able on short notice to reconsider, appreciate and change the direction of effort is indeed valuable, and is one of the factors which contributes to the efficiency and effectiveness of AGARD operations. This flexibility of mind and means has been established in our organization by you, the National Delegates, and has been made possible through the budgetary system which has been developed over the years.

Aerospace Applications Studies Committee

Aerospace Applications Studies, also referred to as Military Committee Studies, were initiated by an NDB decision in March 1971. By July 1973 the first two studies initiated were in the process of being published. Three years later, AAS Nos 3, 4, 5, 5a, 6 and 7 will have been undertaken and finished, AAS Nos 8, 9 and 10 are well underway and Study No.11 initiated. These studies

have now become well established as an important contribution to the fulfillment of the AGARD Mission. While at the beginning most of the study proposals originated within the AGARD Staff, it is now clear that the Military Authorities take a great interest in these studies and, thus, most of the study proposals are now submitted from sources outside AGARD. This development is to be welcomed, as it results in more proposals relevant to the technical and operational problems facing the Military. As was the case with the Panels, I have attended many meetings of the AASC, and again I wish to express my appreciation of the calibre of the Committee members who, like the Panels, have strongly supported the Director by giving advice and assistance where and when needed. Through the "feedback" exercise requesting the opinions of the various recipients of the first three AAS Reports, it is evident that these reports have been well received and of considerable significance. In addition, the interest and appreciation of the NATO Military Committee in the work carried out through these studies serves as a strong indication that this program will continue to serve a special and important purpose in the future.

Consultant and Exchange – Lecture Series Program

Over the last three years requests for consultants have been received from the member countries as well as from Panels and the AASC. A total of 273 Consultant missions have been performed. Of these 86 were requested by the countries, 44 were required by AGARD activities and 143 were contracted for the Lecture Series program. Altogether, these missions comprise of over 670 separate consultations. Judging from the various consultant mission reports and the additional requests received for Lecture Series, this program is serving an important function in meeting our requirements as laid down in the AGARD Mission.

Publications

A major part of the AGARD Technical Program budget is allocated to AGARD publishing. Nearly every AGARD activity in the end results in a publication, for it is in this way that the results of AGARD's work are made available for the NATO Community. Therefore, control of this part of the AGARD program has a significant effect on AGARD total expenditure. AGARD has, through a sound contract with Technical Editing and Reproduction Ltd., of London, been able to maintain and even improve the quality of its publications at competitive prices.

From 1973 through 1975 AGARD published a total of 300 books of an average of 160 pages. In this period nearly 400,000 books have been distributed at an average of about 11 FF per copy, making AGARD the biggest aerospace technical-scientific publisher in the West and one of the largest in the world. This unit price per copy of AGARD publications has remained the same as the one quoted for the previous three year period.

Notwithstanding the fact that AGARD has been able to publish at competitive prices, we have studied and recently initiated a microfiche reproduction programme which is reaching a widening audience. On the one hand, this program was initiated as a precaution to the seemingly deteriorating economic situation. On the other hand, it is aimed at increasing the effectiveness of our publications distribution by making it possible to reach more people interested in the information, and by being able to respond more quickly to requests for reports. In addition, I think that the many libraries in NATO countries will appreciate the opportunity this gives them to improve their "space efficiency". It is our aim to achieve a proper balance between hard copies and microfiche copies in the distribution of AGARD publications, and we are following closely the effects of the new programme.

1976 will also see the publication of an updated version (1952-1975) of the AGARD History, which the first AGARD Director (now Honorary Vice Chairman), Dr Frank L.Wattendorf, edited for the period up to and including 1968. We think this interesting and valuable piece of work should be regularly updated every five years to serve as a continuously current and relevant reference to all members of the AGARD family. A new "face lifted" version of the AGARD Handbook (1976) has also been prepared. This includes the AGARD Charter and By-Laws and is intended as a guide to how AGARD functions.

Special Activities

Some AGARD activities may be termed special, in that they differ in one way or another from the main thrust of AGARD efforts.

The Multilingual Aeronautical Dictionary (the MAD Project) is a major special effort that AGARD has undertaken, and which has involved all the AGARD Panels to a great extent. Phase I of this effort is virtually finished, compiling and defining some 7,000 aerospace terms. Phase II, which comprises the translation of these terms into ten languages (English, German, Spanish, French, Italian, Dutch, Russian, Portuguese, Greek and Turkish) is under way. Current plans are to print the Multilingual Aeronautical Dictionary under AGARD auspices and market it through a commercial publishing company.

AGARD has also been heavily involved in technical work on the four-nation (France, Germany, Netherlands, United Kingdom) cooperative venture of Large Wind Tunnels Engineering Studies. This work has been completed as far as AGARD is concerned, and is now being carried further through a small working group of the Defence Research Group PG 7. One of the immediate results of this engagement was the establishment of AGARD liaison contacts across the Atlantic, assuring full information exchange within this special field of aerospace research and development. AGARD is maintaining a keen interest in this project, and is cooperating closely with the DRG in their further endeavours.

Project 2000 – a proposed technological forecasting study – is currently under consideration by AGARD. The importance the Military Committee has accorded this project is expressed by the presence of the Chairman of the Military Committee, Admiral Sir Peter Hill-Norton at the AGARD March 1976 NDB meeting presenting his views on technological forecasting as related to military planning.

RELATIONS WITH OTHER NATO BODIES

The importance placed on proper coordination of activities by the AGARD National Delegates Board has, as already mentioned, resulted in more determined efforts both within AGARD and in relation to other NATO bodies. A few remarks on the present status of these are given below:

NATO Military Committee

As an advisory agency to the Military Committee, AGARD recommends its Technical Program for approval by the Military Committee and reports to the Committee on the results of its activites. In the past, AGARD Directors have from time to time been requested to present in person short resumés of AGARD activities before the Military Committee. Following such a request, a presentation was given to the Military Committee on 5 June 1975. After the presentation, the members of the Military Committee expressed their keen interest in the activities of AGARD, and later in a letter from the Chairman of the Military Committee, Admiral Sir Peter Hill-Norton, I was advised that the Military Committee wishes that such presentations should become regular (annual) occurrences. I take this to be an expression of increased interest in and emphasis on AGARD activities, which is encouraging and which certainly acts as a stimulus to everyone engaged in AGARD activities.

SHAPE

SHAPE participation in AGARD activitics has increased in importance with the initiation of the Aerospace Applications Studies. While SHAPE has always been represented on the Steering Committee, and the Scientific Advisor to the Supreme Allied Commander regularly attends AGARD NDB meetings, its support is of vital importance in the execution of the Aerospace Applications Studies. I have met great understanding of the need for this special support and, within the stringent requirements which its own activities demand, SHAPE has provided support of decisive value to the AAS program.

SHAPE Technical Center

Through mutual attendance at meetings, the AGARD cooperation with STC has been well established. Lately, these ties have been strengthened by the active participation of STC members in some AGARD Working Group activities. Our intensified communications efforts will I am sure enhance such participation also in the future.

Conference of National Armaments Directors (CNAD)

The previous close cooperation with the Defence Research Group has continued and expanded throughout the last three years. The Large Transonic Wind Tunnel work has already been mentioned, and also the results of many AGARD technical-scientific activities are being fed into DRG. Participation in appropriate activities is also taking place in order to supplement information and avoid unnecessary duplication of efforts. With the increasing importance of our AAS activities, a closer contact has also been established between AGARD and the other Armaments Groups, especially where relevant aerospace activities are involved.

Science Committee

Through the ex-officio membership of the Assistant Secretary General for Environmental and Scientific Affairs in the NDB, a formal link between our two activities has already been established. On the working level additional contacts have developed through the last three years and mutual participation of Executives in Panel planning meetings has been established.

I have here tried to give a small impression of the ties and contacts that have recently been established and strengthened between the various NATO agencies. It goes without saying that due to the continuous yearly changes of membership, such cooperation is not a one-time affair, but must be continuously renewed.

AGARD HEADQUARTERS

The forty-two persons working at AGARD Headquarters here in Paris are tasked with the administration and execution of the decisions taken by the NDB and the activities resulting therefrom. This group of people and the conditions under which they carry out their work are vital to the well-being of the whole organization. I find it, therefore, appropriate to report on some of the progress made in assuring proper use of these resources.

Material Equipment

AGARD is indebted to the French Authorities for the fine condition of the AGARD Headquarters building. Working conditions are excellent, and this contributes to the efficiency of the organization. Inspired by these efforts, AGARD has embarked on a two-pronged renewal program: firstly, of replacing run-down office furniture; and secondly, of reviewing and replacing the office equipment necessary to carry out our work efficiently.

As a result of the review on how to make best use of our personnel, typing, printing and reproduction facilities have to a large extent been renewed with modern equipment, making it possible to meet new and heavy demands on AGARD support from the increasing number of Working Group meetings at AGARD Headquarters. Along the same line an in-house study is underway to assess the possibilities and consequences of computerizing AGARD administration. Keeping in mind that including contracting, AGARD has at any one time of the order of 1000 activities in progress, a case may well be made for such a step to facilitate continuous control over these activities.

Staff – Personnel

The structure of the AGARD Headquarters administrative personnel of Voluntary National Contributions, (VNC's), and permanent staff assures continuous renewal as well as an element of continuity; in my opinion this is very sound. Although not always without its problems, I have found that such a combination, comprising dedicated and able individuals, assures the inspired support AGARD needs. The establishment of the AGARD Staff Association which took place under the former Director has certainly contributed to mutual understanding and cooperation, and the organization

has greatly benefited. I will also take this opportunity to thank the staff for their support and loyalty during these years.

SOME FUTURE PROSPECTS

In simple terms the driving force in AGARD activities is no doubt plain self-interest blended with an element of desire to assist the less technologically developed nations. Therefore, as long as the product of our joint efforts is equal to or greater than that of any one of the AGARD member nations, AGARD will have a sound basis for its existence. Judging from the three past years, I have no doubt that this is the case. Nevertheless, in the changing times we are experiencing we must continue to ask ourselves if AGARD cannot improve its performance.

On the purely technical-scientific level, the Panels are continuously assessing the situation and are working for exchange of information relevant to their military efforts on the frontiers of technical-scientific knowledge. They must certainly continue to do so. The results of the Aerospace Applications Studies over the last few years, and the apparent interest of the Military Committee and SHAPE in them, show clearly that they will be of continuing importance in the years ahead. As far as developments relating to Economy, Energy and Standardization are concerned, all indications are that these problems will be with us for some time into the future. Consequently, they merit continued attention by the AGARD Panels as well as by the AASC.

Looking a little further ahead, however the question arises whether AGARD could serve purposes other than the exchange of information already generated in the various countries. As I have said on other occasions, it is my belief, based on previous experiences with projects requiring coordinated planning and execution, that AGARD can serve an important role in such planning, if the countries wish it do do so. It is not difficult to identify all the "impossibilities" associated with this suggestion. However experience shows that by concentrating on the "possibles", even the "impossibles" can be achieved in the end. The economies envisaged even in the short term, together with the potential economies associated with standardization, ought to be a strong driving force for AGARD to expand on the limited activities already started under the heading of "Cooperative Projects".

In closing, I wish to extend my thanks to the AGARD Chairman, Dr Alexander Flax. I hope he will not mind my saying that I have personally felt, during our joint terms of office, a very close accord with him and his views and endeavours. I should like to thank him and you, the National Delegates, for the guidance and direction you have given me. Finally, I must extend my deep appreciation to all the members of the Steering Committee, the Panels, the Aerospace Applications Studies Committee and the whole AGARD community for the assistance I have received and the personal satisfaction it has given me to occupy this position for the past three years.

AGARD STUDIES HURRICANE ELOISE

The final meeting of the Aerospace Applications Studies Working Group No.7 on *Suppression of Radars Associated with SAMs* convened at Eglin Air Force Base in Florida on 20 September 1975. This site had been selected so that the group might visit some of the interesting radar test sites in the area. The meeting had barely started when the base shut down to prepare for the possibility that Hurricane Eloise, then churning eastward in the Gulf of Mexico, might hit the base.

In fact, early in the morning of 21 September, Eloise changed course and smashed into the Florida coast; the eye of the storm passed just a few kilometers to the east of the base; the fury of the tempest spawned over a half dozen tornados on the base itself. Not a hangar was left standing as millions of dollars of damage was done. One hangar had its roof peeled off as if by a giant can opener; another lost an entire wall.

As the base began preparation for the storm, the Group decided to leave its motel, located right on the beach. and this proved fortunate since this particular motel suffered the loss of a roof and damage was sufficient to merit nationwide television news coverage.

The Group moved into transient quarters on the base. At dawn the storm struck. The study group slept in their transient quarters, blissfully unaware that the storm had turned toward the base. The first realization for some was the fact that they were awakened by their ears popping, due to the rapidly decreasing pressure. The deafening roar outside soon confirmed suspicions. The one-story transient quarters were quite old and gave the impression of having been built originally for relatively temporary use.

In due course the storm subsided. Pushing aside a metre-deep pile of débris, outside their doors, the group members emerged to discover the full extent of the storm's damage. The morning was spent in trying to find food. None of the kitchens or mess halls were in operation; there was no gas or electricity and few people were at work. Finally, Army C rations were obtained at a storm shelter; the ensuing picnic was hardly haute cuisine, but even the French member participated.

Despite lost time, the meeting was successful, though no radar sites were visited as they had all been damaged. And no one was hurt. Well, almost no one. The next night when one member struck a match to light a candle, the match exploded into his eye and he had to visit the hospital. Then the next night, with a bandage on his eye and walking about by candlelight, he kicked a bed and split a toenail which took months to heal. But have no sympathy for him – he was a Floridian and the only group member who had experienced anything like Eloise before.

Von Kármán Medals 1975

The 1975 Von Kármán Medals were presented to Mr John B. Scott-Wilson (UK) and Professor G.Gabrielli (Italy) at the AGARD Annual Meeting in Ottawa in September 1975. Above, Mr Scott-Wilson, accompanied by his wife, is seen accepting his Medal from Dr H. L'Heureux, Chairman of the Canadian Defence Research Board. Professor Gabrielli, who was unfortunately unable to be present at the meeting, is shown below. The citations which accompanied the Medals were as follows:

Mr JOHN BEAUMONT SCOTT-WILSON has made important contributions to the work of AGARD in two separate capacities – as a member and Chairman of the Flight Mechanics Panel between 1966 and 1974, and as the first Chairman of the Aerospace Applications Studies Committee at the time of its formation in 1971.

In the field of flight mechanics, he made significant technical contributions to the activities of the AGARD Panel, emphasizing long-range planning and continuity as elements in the management of its technical programme planning. He was largely responsible for the formation and organization of the Aerospace Applications Studies Committee. Under his guidance the work of the teams of military and civilian scientists and engineers who have prepared aerospace applications studies became an increasingly important contribution to NATO's military requirements in aerospace science and technology.

PROFESSOR GIUSEPPE GABRIELLI has served AGARD as a National Delegate continuously since 1952. He was a close friend and colleague of Dr von Kármán, and played a significant role in the promotion of the AGARD concept and in the establishment of AGARD. His wide experience and his international reputation in aerospace research and development, both in the academic world and in industry, have formed the basis of valuable contributions to the scientific and technical activities of AGARD. His leadership, guidance and practical experience have been of inestimable value to many AGARD projects.

MR FRANK R.THURSTON IS NEW AGARD CHAIRMAN

Mr Frank.R.Thurston, Director of the National Aeronautical Establishment, Canadian National Research Council, has accepted unanimous election by the AGARD National Delegates Board as Chairman of AGARD. He will serve for three years commencing in March 1976. Mr Thurston's connection with AGARD dates from 1955 when he became a member of the Structures and Materials Panel. He has been a member of the Panel continuously since then and served as Chairman from 1957-1960. In 1960 Mr Thurston became a Candian member of the National Delegates Board.

Mr Frank Russel Thurston was born in Chicago, Illinois and was educated at the University of London, where he took a B.Sc in Physics in 1940. Until 1947 he was a member of the scientific staff of the British National Physical Laboratory in Teddington, England.

In 1947 Mr Thurston joined the Division of Mechanical Engineering of the Canadian National Research Council, and in 1959 assumed his present appointment as Director of the Council's National Aeronautical Establishment.

Mr Thurston is a member of many national and international committees and organizations concerned with science and engineering, including the Institute of Physics, the Canadian Aeronautical and Space Institute and the Commonwealth Advanced Aeronautical Research Council. He is the author of numerous publications on the theory of structures, fatigue of materials and structures and aerodynamics.

DR ROBERT H.KORKEGI TO BECOME NEW AGARD DIRECTOR

Dr Robert H.Korkegi of the United States will succeed Mr Olav E.Blichner of Norway as Director of AGARD on 1 July 1976.

Dr Korkegi has had a long association with AGARD and the AGARD community. His first direct contact was in 1956 when he served as a consultant on hypersonic aerodynamics. From 1957 to 1964 he was Technical Director of the von Kármán Institute for Fluid Dynamics at Rhode St Genèse, Belgium, a post for which he was nominated by the late Professor Theodore von Kármán. Since 1969 Dr Korkegi has been an active member of the AGARD Fluid Dynamics Panel.

Dr Korkegi was born in Italy, lived his early years in Switzerland, Belgium and France and attended Italian and French as well as American schools. During World War II, he served with the US Army Combat Engineers in the United Kingdom, France and Germany. After the war he resumed his studies in mechanical engineering at Lehigh University and received his Bachelor's degree in 1949. He pursued graduate studies at the California Institute of Technology, leading to an M.S. in Aeronautical Engineering in 1950 and a Ph.D. in 1954. For his Ph.D. thesis he undertook some of the early work on turbulent flows at hypersonic speeds and was the first to show the persistence of disturbances in hypersonic laminar flows and the reversal of transition Reynolds' number at high Mach numbers. Between 1954 and 1957 Dr Korkegi was a Research Associate at the University of California Engineering Center where he worked on hypersonic aerodynamics and on pressure measurement techniques for transonic and supersonic aircraft. The

latter research led to his development of a simple aerodynamic compensating device for the accurate measurement of static pressure, successfully tested in flight on many of the "century" fighter aircraft. During this period, he also lectured in the aerodynamics of compressible fluids at the University of Southern California.

In 1964, Dr Korkegi was appointed Director of the Hypersonic Research Laboratory (which became the Theoretical Aerodynamics Research Laboratory) of the Aerospace Research Laboratories at Wright-Patterson Air Force Base. Under his leadership the Laboratory evolved an important in-house research activity on viscous interaction phenomena at high speeds emphasizing three-dimensional turbulent flows at high Reynolds numbers, flow separation, and boundary layer control. When the Aerospace Research Laboratories were closed in June 1975, he became Senior Scientist at the Air Force Aero Propulsion Laboratory at Wright Patterson Air Force Base.

Dr Korkegi has served on several national and international committees and study groups, including the NASA Sub-committee on Fluid Dynamics, the AIAA Technical Committee on Fluid Dynamics, and the Doctoral Council of the Air Force Institute of Technology; he also served as General Chairman of the AIAA 10th Aerospace Sciences Meeting in 1972. He has been the author of over 40 publications, mainly on aerodynamics and boundary layer phenomena, transonic flow, hypersonic facilities and early work in hydrodynamics and structures. The AGARD community takes this opportunity to welcome Dr and Mrs Korkegi to AGARD Headquarters, and to wish Dr Korkegi every success in his new appointment as Director.

MR D.B.SMITH, UK NATIONAL COORDINATOR, RETIRES

Mr Denis Bonham Smith ("DB", as he was known to his friends) retired from UK Government service at the end of December 1975. He had been UK National Coordinator for AGARD since 1966, and had become well-known to all members of the AGARD community, and especially to those who were in any way concerned with AGARD meetings or activities in the United Kingdom.

"DB" was educated at St Paul's School and Corpus Christi College, Oxford, where he read mathematics and engineering science. Before World War II he was a scientific officer at the Admiralty Research Laboratory where he worked on the airflow over the decks of aircraft carriers and the bridges of destroyers. During the war he served with the Royal Air Force in Bomber Command and was demobilized with the rank of Wing Commander. He was mentioned in despatches (twice) and awarded the Order of the British Empire.

After the war he joined English Electric Company and Folland Aircraft Ltd. (later Hawker Siddeley Aviation Ltd.) as a designer, working on the Canberra, the world's first jet bomber, and the Folland lightweight ejection seat. He joined the Ministry of Aviation in 1956 and eventually transferred to the Ministry of Defence as part of a British Government reorganization.

Denis Smith has always been a keen supporter of volunteer forces, and he commanded the Hampshire and Isle of Wight Wing of the Air Training Corps, the RAF Cadet organization. He made his first flight in an RAF aircraft in 1929 in a Bristol fighter of the Oxford University Air Squadron; his last service flight was in 1970 as pilot of an RAF Chipmunk, after over 40 years of service in the RAF and its reserves. He intends to continue flying.

Mr Smith was appointed a Deputy Lieutenant of Hampshire, where he made his home, in 1965. He has been a member of the Governing Body of Eastleigh Technical College since 1961 and its Vice Chairman since 1967.

AGARD owes a great deal to DB's efforts on its behalf in the United Kingdom; his position will be hard to fill. All his friends and all members of the AGARD community will wish him and his wife a long and pleasant retirement.

In December 1975 D.B.Smith visited AGARD Headquarters before his retirement. He was entertained at an AGARDolunch and presented with some mementos of his association with AGARD

ELEVENTH AGARD ANNUAL MEETING

THE ELEVENTH AGARD ANNUAL MEETING was held in the Government Conference Centre, Ottawa, Canada in September 1975. The texts of the addresses on Canadian aeronautical research and development which were delivered at the meeting, have been published separately in the AGARD 1975 Annual Meeting Report. These illustrations show:

TOP: Major General G.Henon, NATO(IMS) (left) and Mr G.Schoner, NATO (IS) with an example of Canadian Indian craft.

CENTRE: Colonel (Retired) John M.Coulter, NASA Coordinator for AGARD, and Mrs Coulter.

BELOW: A Chairman's eye view of the AGARD National Delegates at work. The backs are those of Dr Alexander H.Flax, Chairman of AGARD (right) and Mr Olav E.Blichner, AGARD Director.

THE VON KARMAN INSTITUTE CELEBRATES ITS 20TH ANNIVERSARY

by

Rolland A.Willaume
Director Plans & Programs
AGARD

THE EARLY DAYS

During the year 1955 soon after AGARD had been organized, Dr von Kármán and the AGARD Staff were looking for new ways to promote and encourage scientific cooperation at an international level. It was also part of the responsibility of the Consultant and Exchange Program to carry out various surveys of the existing potential of the NATO Nations in aeronautical research and to consider which facilities would eventually be available for international cooperation.

One of the surveys made during a mission in Belgium showed that the very well planned aerodynamic laboratory there was not fully used for research by Belgium and could possibly be transformed into a Center where Engineers from NATO Nations could be trained in the very important field of experimental aerodynamics. Such an idea was a logical complement of the newly established Consultant and Exchange Program in AGARD and the project was immediately enthusiastically received by Dr von Kármán, who decided to give to it not only his support but his attention and his personal backing.

A Committee selected from among the most distinguished European aerodynamicists composed of Professor Haus (Belgium), Professor Zuikker (Netherands), Professor Young (UK), Professor Malavard (France) was formed. It was supported by Dr Wattendorf and Mr Willaume of the AGARD Staff and met at AGARD Headquarters to study the proposal, make positive criticism and work out a program for a nine month course and a plan for re-equipping the Center. This was the beginning of what became the TCEA, The Training Center for Experimental Aerodynamics.

The Belgian National Delegates, following the first contact made during the AGARD General Assembly in Ottawa in 1955 and the favourable report made by the Committee, were able to convince their Government that the project could be very valuable. In addition, thanks to the efforts of Dr von Kármán, the United States Air Force agreed to assist on a trial basis the establishment of the project in cooperation with the Belgian Government. General Thomas B.Larkin, Head of the Mutual Weapons Development Program at that time, was instrumental in establishing an informal Belgo-American understanding signed in 1956.

On 4 October 1956 of that year, in spite of many uncertainties, the first course was started, with the enthusiasm of all concerned. Slowly, and with AGARD interest and support, the Center started to build its programs of teaching and to modernize its equipment. Many Nations assisted in providing research equipment and aerodynamic facilities in the best spirit of international cooperation.

NATO AND NATIONS' SUPPORT

In 1959, after a three year trial period, the NATO Council agreed that the NATO Nations interested in the use of the Center should support it financially through a cost-sharing formula. At the start, ten Nations participated, then fifteen and, today, thirteen are financing the project. An Ad Hoc Working Group on the financing of the Center was formed by NATO and continues to date to review the budget and to report to the NATO Council on policy problems and funding.

After the death of Dr von Kármán in 1963, the Center was re-named the von Kármán Institute for Fluid

The plaque commemorating Dr von Kármán at the Von Kármán Institute for Fluid Dynamics, Rhode-St-Genèse, Belgium

The central building of the Von Kármán Institute for Fluid Dynamics complex at Rhode-St-Genèse, near Brussels, Belgium

Dynamics. The Board of Directors elected Professor A.D.Young, Head of the Department of Aeronautical Engineering of the Queen Mary College in London as its new Chairman. Soon after, in 1965, the NATO Council requested that the NATO Science Committee make an assessment of the Institute's work and usefulness to the NATO Nations. The results were the establishment of a long range program endorsed by the Science Committee in 1966. From then on, the VKI was able to plan a dynamic and well-balanced program.

THE VKI ORGANIZATION AND FACILITIES

Professor Young, Chairman of the Board, is assisted by the Vice Chairman, Professor F.Haus from Belgium who in 1972 succeeded Mr Nottet who had been Vice Chairman since 1956. The following nine nations are represented on the Board by their most prominent experts in aeronautics or fluid dynamics: Belgium, France, Germany, Italy, The Netherlands, Norway, Turkey, UK, USA. Supported by the NATO Science Committee, and with the assistance of the AGARD National Delegates Board, the AGARD Fluid Dynamics Panel and the AGARD Consultant and Exchange Program, but mainly thanks to its own high-level potential, the VKI is now one of the best examples of the role of NATO in fostering international co-operation in non-military activities.

The following is a summarized description of the VKI today, and especially of the two main aspects of the Institute's programmes: the *Educational Programs* and the *Research Activities.*

Educational Programs

VKI Diploma Course in Fluid Dynamics

The Diploma Course, now in its twentieth year, comprises a balanced mixture of lectures, laboratory sessions, and independent research. It is designed specifically for the graduate engineer or scientists desiring an additional year of specialization in one of the following areas of fluid dynamics: aeronautics/aerospace, computational fluid dynamics, general and environmental fluid dynamics, and turbomachinery. Test facilities are available for training and research on a scale not possible in most universities; thus, the course complements the teaching programmes offered within the supporting countries. Attendance is maintained at 20 to 30 candidates per year. Tuition is free for a citizen of any NATO nation currently providing support to the international budget. Nearly 400 students from 14 countries have received the VKI Diploma since it was first offered in 1956.

The Doctoral Program

Selected members of the Diploma Course are invited to remain at VKI for the purpose of carrying out original research which may lead to the preparation of a doctoral thesis in one of the areas of fluid dynamics cited above. Since 1963, when the first degree was awarded, 31 candidates have successfully defended theses before university faculties in a number of countries. Annual attendance varies from 20 to 25 at present.

Lecture Series and Short Courses

Short courses on highly specialised subjects were first offered to engineers and scientists from industry, research institutes, and universities in 1962. They provide a unique forum within Europe for fluid dynamicists from all the NATO nations to present and discuss recent research and development activities in many fields. Ten of those Lecture Series or Short Courses per year are now organized, many of them in close cooperation with AGARD (Fluid Dynamics Panel and the Consultant & Exchange Programme). The Lecture Series and Short Courses have reached a very large number of engineers within the NATO Nations and the annual attendance – not inclusive of the VKI students–is approximately 600.

Special Programs

Specific programs are frequently tailored to the need of special groups from Industries or Universities. Their duration may be of one or several days, and sometimes up to one year.

To conclude, it must be emphasised that the VKI seeks to provide appropriate educational programs that best meet the needs of the sponsoring NATO countries. The selected programs are aimed at complementing rather than duplicating national training programs. The equivalent of about 80-85 years of academic training are provided annually.

Research Activities

Subjects:

Basic and Applied research at the Institute is

carried out within the following four departments, the names of which describe the principal activities:

Aeronautics/aerospace Department: VSTOL aerodynamics, aero-acoustics, transonics, supersonics, re-entry gas dynamics, etc.

Computational Fluid Dynamics Department: Numerical treatment of inviscid flows and the Navier-Stokes and boundary layer equations.

General and Environmental Fluid Dynamics Department: Mechanics of turbulence, two-phase flows, wind effects on structures, heating and ventilation systems, fluidics, heat exchangers, pollutant dispersal, etc.

Turbomachinery Department: Aerodynamic design of axial and radial compressors, gas and steam turbines, pumps, etc.

Funding

The impact of the Research Programs on the Von Kármán Institute Budget, is shown by the fact that research income from external organizations amounted to U.S. $290,000 in 1974-75, or approximately 20% of the total VKI budget. Funding originated from governmental agencies in four countries (Belgium, France, U.K., U.S.A.) and from a large number of private companies in seven countries (Belgium, France, Germany, Italy, Netherlands, U.K., U.S.A.). It should be added that the research income supports much of the doctoral program.

Research Results

The results of research performed at the Institute are often published in books, journals and technical notes and are presented at various international scientific meetings. Approximately 250 scientific papers have been published or presented since the founding of the Institute. In addition, research results are frequently presented in the context of the VKI Lecture Series and/or invited seminars. It goes without saying that the VKI has made many contributions to the Fluid Dynamics Panel of AGARD.

AGARD AND THE VKI

As has been mentioned earlier AGARD and the VKI have maintained a useful co-operation for the last 20 years; the permanent links existing between the Fluid Dynamics Panel (FDP) of AGARD and the VKI must be specially stressed. Each year the FDP sponsors one or two Lecture Series organized by the VKI, and these are now one of the permanent tools used by AGARD to bring together scientists or engineers who desire to receive an up-to-date review of a given field of Fluid Dynamics. The National Delegates of AGARD assist in selecting and recommending students from their nations to participate in the VKI educational programs or courses. The co-operation between the two organizations is highly beneficial to both, and AGARD often uses the excellent facilities of the VKI for the organization of AGARD meetings.

CONCLUSIONS

It is hoped that the above will provide readers with a summarized introduction to the von Kármán Institute. In fact, however, it is almost impossible to describe the very special and dynamic atmosphere that is found on the site. This is probably due to the high spirit of the Professors and students working together as a unique team in the best spirit of international co-operation. Those who have been fortunate enough to be associated with the Institute have indeed appreciated the unique concentration of quality of teaching, devotion of the Staff and the high quality of the research facilities made available to the students.

The personal ties established among the students, many of whom come to have important responsibilities in their own countries, is a rewarding spin-off from the activities of the Institute.

The VKI has another challenging task ahead – to maintain at the highest level the international reputation painfully acquired during the last twenty years.

The NATO Nations who have been wise enough to invest in this project have shown that their judgement was right. The benefits that they have received in return cannot be evaluated in francs, dollars, pounds or marks, but only in the seeds that have been planted for a closer scientific and international understanding. Certainly in the years to come this will be seen as one of the most significant examples of scientific cooperation in the free world. All the Professors and the Staff of the VKI should be proud of what they have done. AGARD will spare no efforts to continue to provide them with support, understanding and friendship.

The Author would like to express his thanks to Professor Jean Smolderen, Director, and Professor John Wendt, who have provided him with up-to-date data and information on the VKI's latest programs and activities.

VKI TEACHING STAFF

From 1956 until now, the Directors of the VKI have been: Dr R.P.Harrington, US: 1956–1958. Col. W.G.Brown, US: 1958; Dr L.H.S.Sterne, UK: 1958–1962; W.F.Campbell, Canada: 1962–1965; Mr R.O.Dietz, US: 1966–1970 and Professor J.J.Smolderen, Belgium, since 1970. Five highly qualified Professors are assisted by three Associate Professors and five Assistant Professors, representing six NATO Nations.

VKI FACILITIES

As with many modern national research establishments, the VKI uses a wide range of first-class, often unique facilities for Research and Teaching. Such facilities are operated by teams of highly qualified technical assistants and very skilled mechanics. These facilities include: two low-speed tunnels, two supersonic tunnels, two hypersonic tunnels, one longshot tunnel, one free piston shock tube, one compression tunnel, one low-density tunnel, four laboratories on: fluidics, heat transfer, gas-particle, and electronics. There are two cascade tunnels (high and low speed) and two high speed compressor facilities. The Institute facility includes also computer, electronic, model shop, photography and printing sections and a very well-equipped library.

AGARD ACTIVITIES IN AIR TRAFFIC CONTROL

by

André Benoît
Chairman, Guidance and Control Panel

INTRODUCTION

According to the AGARD Charter[1] it is "the Mission of AGARD to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for ... improving the cooperation among member nations in aerospace research and development ...".

The scientists, engineers and technicians grouped in the AGARD family have contributed greatly to the understanding of complex phenomena and to the solution of extremely difficult problems associated with the flight of aircraft conducted in the most severe conditions. A variety of basic disciplines and advanced technologies have benefited from AGARD activities; AGARD literature on fluid dynamics, structures and materials, aircraft design, guidance components, bionics, etc. is impressive and certainly constitutes a valuable and up to date source of information.

However, when this literature is explored, it soon appears that every effort is made in order to permit an aircraft to fly in extreme conditions of speed, visibility, load, temperature and altitude. But once a series of aircraft are flying and sharing the same airspace, another family of problems arises in association with the relative motion of all the aircraft involved either in the air or on the ground. For this category of problems, appreciably less information is available and a total scientific approach remains to be formulated.

Until recently it would seem that the scientific component of the aerospace world in general, and of the AGARD family in particular, has hardly been involved in the traffic aspects of air transport. The reasons underlying this situation are numerous and varied. They certainly have a historical flavour, but it is beyond our purpose to analyse them. It is clear however that the expedition of traffic and the adherence to schedules should be improved appreciably; holding and stacking times of the same order as the corresponding scheduled flight times have been observed both in the United States and in Europe, and similar delays on the ground are not rare. In addition, military and civil requirements exhibit differences which, when specific defence aspects are involved, may become appreciable. Nevertheless, both have common facets which could be reflected at the development stage. It appears essential that all concerned with air traffic control (ATC) have a good understanding of each others' requirements, constraints and possibilities. This implies that they keep aware of both the evolution and the current developments undertaken in related areas; topics of particular interest should embrace the evolution of the air traffic, the economic context and in particular energy conservation aspects, environmental protection, the use of mathematical theories of traffic and, in general, the progress made in science and technology.

In 1970, the Guidance and Control Panel recognized this situation. It sincerely felt that air traffic control could gain appreciably more than in the past from the AGARD potential. Accordingly, it arranged to offer an international podium to all those involved in air traffic, including operators, users, controllers, concept designers and equipment manufacturers.

PROGRAM OF ACTIVITIES

The program established by the Guidance and Control Panel, essentially included the organization of one general symposium devoted to air traffic control systems on the one hand, and, on the other hand, the development of a general survey of the problems, principles, techniques and tools of air traffic control. It was hoped that the symposium would generate a feedback to the Panel which could then adjust the future parts of the program. This feedback worked extremely well and an unexpected amount of encouragement was received confirming the need to proceed with a broader program which covered most facets of the ATC field. Accordingly, a second symposium devoted to the plans and developments of air traffic systems was held, and an extension of these activities is being contemplated.

AIR TRAFFIC CONTROL SYSTEMS

The first symposium entitled *Air Traffic Control Systems* was held in Edinburgh, Scotland on 26–29 June, 1972. Initially, the meeting was planned to extend over a three-day period. The interest raised by the announcement of the symposium and the response of the ATC world to the call-for-papers were such that a four-day meeting certainly appeared more appropriate. Ninety-six papers originating from eight different NATO countries were submitted for possible presentation. The program, as a general policy, placed emphasis on new techniques, new approaches, future aspects and conceptual developments, as opposed, for instance, to detailed descriptions of equipments. As indicated by Mr N.Coles in his welcome address[2], "the subject attracted a record attendance for any AGARD meeting in the United Kingdom" and, in fact, established a record attendance for any AGARD panel meeting.

In his keynote paper *Status and Trends in Military Air Traffic Control Systems*, Major General A.R.Shiely, Jr indicated how the civil/military integration and compatibility which "have not progressed as far as might be desired" should and could be improved in the future. The General further discussed "the challenges that military aviation will create for air traffic control in the years to come". The Air Defense Control System and the Air Traffic Control System have quite a number of common characteristics. Besides common objectives such as safety and efficiency, they often share the same basic techniques and equipments. Of course, the military

have "special needs for mobility and survivability" but nevertheless results obtained in one field usually impinge on the developments conducted in the other. In this respect, the military "can point with some pride to the fact that the radar, beacon and computer technologies upon which our current systems rely are largely the products of military research and development efforts". Similarly the military program for the integration of navigation, communication and identification may have an appreciable effect on the definition and development of future air traffic control systems. Also, tactical air control systems, regardless of the equipment used, have benefited from the experience gained by the civilians in exercising the control en route and in terminal areas.

The Advisory Group for Aerospace Research and Development (AGARD) is certainly the most suitable institution to offer both the military and civil authorities a place to compare their requirements, exchange their views, compare the results obtained and work together towards international standardization and compatibility of systems.

This, in fact, was the first reaction we received on this first AGARD Symposium devoted to ATC, mainly from the military side. A second reaction, mainly originating from the civilians on both the management and the research and development sides, was an expression of general satisfaction for the technical program offered. This reaction also clearly indicated that a continuation of this program would be appropriate. These comments, together with the encouragement received from Dr M.I.Yarymovych, who closed the meeting as Director of AGARD, led to the planning of the second symposium organized and sponsored by AGARD on ATC matters.

A SURVEY OF MODERN AIR TRAFFIC CONTROL

Potential contributors to the survey proposed by the Guidance and Control Panel on principles and techniques of air traffic control, were contacted. It soon appeared that this project was considered favourably by all the institutions that were approached; its realization was a pleasant example of true international scientific cooperation.

In the open literature, no general synthesis of air traffic control was available in the form of an adequate textbook, and no readily available document could be found which would constitute a practical overview and provide a thorough introduction for those joining this fascinating field.

It was in an attempt to fill this gap that GCP initiated the AGARDograph entitled *A Survey of Modern Air Traffic Control*[3]. When the relevant work was underway, our attention was drawn to a special issue, on aeronautical communications, in an American Journal, the Institute of Electrical and Electronics Engineers. *Transactions on Communication*, Volume Com-21, November 5, which appeared in May 1973. In view of the information presented in this excellent publication, the contents of the AGARDograph were slightly revised in order to avoid any duplication, especially when dealing with US systems.

Published in July 1975, *A Survey of Modern Air Traffic Control* is divided into five main parts as described in the following outline extracted from the preface.

The first chapter describes the *General Organisation of Air Traffic Control*. The principles of ATC are outlined, the principal components are presented and possible concepts are discussed.

The second chapter is devoted to the *Human Factors in ATC*. This, in view of the progressive implementation of automation, was considered an important subject and it is discussed in some length. Indeed, the position of a man responsible for the proper conduct of control, while surrounded by automated or semi-automated elements, can be a very debatable topic. Although the different aspects of such a subject can hardly be separated, an attempt was made to cover separately the interaction between the human controller and the machine, the views of the psychologist and the medical aspects. In addition, there is a brief outline of the International Association which groups most of the associations of air traffic controllers.

The third chapter is entitled, perhaps too ambitiously, *Automation of Control Procedures*. It covers the main techniques associated with the implementation of automation and is divided into five main sections. A first section, entitled *Principles and Applications of Automation* covers the general principles of automation and automatic data processing and illustrates the introduction of automation in ATC systems. The second section covers the *Conflict and Collision Avoidance Systems*. The first paper places the emphasis on an onboard collision avoidance system and on its potential compatability with the conventional ground based control. The second paper describes the ground based collision avoidance systems developed in the United States, namely the En-Route Conflict Alert, now in operation, and the Intermittent Positive Control which is being developed by the Federal Aviation Administration. The third section comprising three papers, is devoted to *Flow Control*. The first paper states the problems and presents the possible and recommended approaches to a solution; the second deals with local and regional flow metering and control; the third paper shows how modern control theory can be applied to scheduling and path stretching manoeuvers of aircraft near the terminal area. The fourth section is devoted to *Aircraft Trajectory Prediction*. The paper presented shows the development of a method of predicting accurate aircraft trajectories for ATC purposes. The emphasis is placed on the constitution of an aircraft performance handbook including detailed data, in a compact form, of climb, cruise and descent for individual aircraft. The fourth section constitutes a critical survey of various studies which have been conducted in order to produce a safe approach to the reduction of *Route Centreline Spacing*.

Chapter four describes some of the main *Technical Aids to Air Traffic Control*. It is not intended to cover all possible aids in this limited document, but a selection of topics has been made with a view to complementing existing literature. The chapter has been divided into seven main sections dealing respectively with: *Ground Based Navigation Aids*; *Self Contained Navigation Aids*

which for coordination reasons was limited to the relation between inertial navigation and air traffic control; *Landing Guidance Systems* including categorization of landing conditions, technology, ICAO Instrument landing system and the microwave landing system; *Surveillance*, more specifically the digital radar data processing for en-route air traffic control; *Visual Display* techniques; *Computer and Processing Facilities*, including the software and hardware aspects; and, finally, a section devoted to the *Use of Satellites for ATC Purposes*. Other topics, such as secondary surveillance radar and communications, especially digital communications (data link), which were not included should certainly be included in an overview of air traffic control; it is intended to cover these topics in a subsequent document specifically devoted to surveillance and communications.

Finally, the fifth and last chapter describes *Operational Air Traffic Control Systems*. The systems which have been chosen for this illustration exhibit a relatively high degree of automation and include European as well as North American examples.

As noted, some aspects of ATC have not been covered in this book. These include, in particular, the subject of communications and more specifically digital communications, the classical techniques of radar tracking and the position of the pilot in the ATC loop. The sole reasons of such omissions are either the availability of the information elsewhere or space limitations. In this last case it is hoped that the Guidance and Control Panel will complete the work as part of its future program of activities.

PLANS AND DEVELOPMENTS

As indicated, the encouragement received following the Edinburgh meeting, led the Guidance and Control Panel to consider the organisation of a second symposium devoted to ATC matters. The conferences, grouped under the heading *Plans and Developments for Air Traffic Systems* were held at the Transportation Systems Center, of the Department of Transportation, in Cambridge, Mass., USA, on 20–23 May 1975. The support and assistance received from the Federal Aviation Administration in the preparation and the conduct of the meeting deserve a special mention.

This time again, as a result of the call-for-papers, about one hundred articles were submitted for presentation at the meeting. As indicated in the Conference Overview presented by David Israel[4], it was very difficult to reduce these to a manageable number. In an attempt to cover a range of topics as wide as possible, papers dealing with similar subjects were combined into survey papers; in this respect the understanding and cooperation of the authors concerned were greatly appreciated.

The time allowed for each verbal presentation was limited to 20 and 40 minutes for short and survey papers, respectively. In spite of this measure, only 39 papers could be selected for the program. Accordingly, several topics, although of great interest, could not be covered at the meeting; these included for instance specific subjects associated with the operation of STOL aircraft and airborne collision avoidance systems.

In the keynote session of the Edinburgh meeting, Major General H.R.Shiely, Jr had placed the emphasis on military requirements, while G.Trow, Director Operations, EUROCONTROL, illustrated practical ATC achievements resulting from efficient European co-operation. In contrast, in Cambridge, Mass., James E.Dow, acting administrator of the Federal Aviation Administration, placed the R & D effort in the management perspective[4] and developed the following theme: "Research and development is not an end in itself. It can only be financially supported and properly managed in the total context of the air traffic control system in field operational use. I feel very strongly that air traffic control is a *system*, from the requirements stand point. I submit that part of our problem of delivering research and development products on implementing the results of R & D is the fact that we have not done a good enough job of integrating these efforts into the total system in the early states."

The views of the users on any development in air traffic control systems is of course of great importance. Accordingly, a representative of the airlines was invited to present these in a keynote address. Benjamin F. McLeod, Vice President Communications, Pan American World Airways, kindly accepted our invitation and entitled his paper "Management Views on Major Issues Facing the Airlines".[3] Indicating, in particular, that "for many airlines the first priority is survival", Mr McLeod in conclusion urged all concerned carefully to study the economic implications of any new system or avionic equipment, and appealed to all to assist in promoting better airspace planning.

The meeting itself (apart from the opening ceremony and the keynote addresses) was divided into seven half-day sessions as shown below. Session 1 was devoted to *Navigation* and included three sub-sessions devoted respectively to area navigation, strategic control and new systems, namely OMEGA and the Global Positioning Systems. Session 2 covered *Surveillance* and was organized under the following headings; Radar, Air Traffic Control Beacon Systems, ADSEL/DABS and Military/Tactical. Session 3 dealt with *Automation* and included five chapters; Human Aspects, Flow Control, Conflict Detection and Resolution, Intermittent Positive Control and Integrated Communications, Navigation and Identification. Session 4 on *Airports* dealt with a variety of topics, namely Capacity, Surveillance, Wake Vortices and Fog Dispersal. Session 5, entitled *Approach and Landing* was divided into five chapters dealing respectively with Microwave Landing Systems, Instrument Landing Systems, Visibility Measurements, Independent Landing Monitors and, finally Metering and Spacing. Session 6 dealt with *Advanced Concepts* and included three chapters on Future Systems studies, Dispersed Systems and Satellites. Finally, a short Session 7 on *System Performance Measures* completed the technical program of the symposium.

The proceedings of the conference, which will appear in the Spring of 1976 as AGARD Conference Proceedings 188, include in addition to the papers presented, the Keynote Papers, Conference Overview and Conclusions and the main discussions which followed each presentation.

It may be of interest to note that about 330 persons enrolled following the announcement of the

meeting, while 217 actually attended the Conferences. A report on this symposium written by V.D.Hopkin, Royal Air Force Institute of Aviation Medicine, Farnborough, UK, appeared in *The Controller*, the Journal of the International Federation of Air Traffic Controllers Associations (IFATCA). Since the competence and objectivity of David Hopkin are well known, his appraisal of the meeting as summarized in the conclusions of his paper may be of interest to members of the AGARD community:

"They (the conferences) provide a good up-to-date summary of current plans and developments in air traffic control systems, a comprehensive survey of current and future technical developments of relevance, and a glimpse into the long term plans for air traffic control systems. Inevitably in such a broad subject as air traffic control there can be disagreements on whether certain topics were correctly emphasised. But on the whole this conference provided a thorough and detailed appraisal while contriving to be surprisingly broad in attempting to cover the whole subject as the previous conference in Edinburgh had also done. A recurring theme was the need to be cost conscious, to be cautious and critical in accepting new developments, and to be sure of their value both operationally and financially before they are introduced. Automation clearly will increase and some of the results which can be obtained already are technically highly impressive."

CONCLUSIONS AND RECOMMENDATIONS

The response of the ATC community to the program outlined in the preceeding paragraphs constitutes a valuable encouragement to those in charge of the definition and implementation of the future activities of AGARD.

The comments received clearly confirm that AGARD quite adequately offered a podium for the presentation and discussion of research and development in ATC, which is not available elsewhere. The amount of material submitted for presentation and the attendance at the Conferences also reflect the need for such a forum.

In conclusion, it is recommended that the Guidance and Control Panel analyse the suggestions received from both the military and civil representatives of ATC, and take them into account when establishing a future program of activities.

REFERENCES

1. *The AGARD Charter*, May 1971.
2. *Air Traffic Control Systems*, AGARD CP-105, June 1972.
3. *A Survey of Modern Air Traffic Control*, AGARD AG-209, Vols.1 and 2, July 1975.
4. *Plans and Developments for Air Traffic Systems*, AGARD CP-188, Spring 1975.

PROFESSOR ANTONIO FERRI

It is with deep regret that we record the sudden death on 29 December 1975 of Professor Antonio Ferri, a member of the AGARD Propulsion and Energetics Panel since 1957, and its Chairman from 1967 to 1969.

Professor Ferri, who was Director of the Center for Interdisciplinary Programs, Director of the Aerospace Laboratory and Astor Professor of Aerospace Sciences at New York University, had a distinguished and colourful career. He was born in Italy and received Doctorates in Electrical Engineering and Aeronautical Engineering from the University of Rome. Before World War II he worked for the Italian Air Ministry and became Head of the Supersonic Wind Tunnel at Guidonia, Italy – the first windtunnel to be put into operation and the largest until 1942. Dr Ferri served with the Italian resistance movement after 1943, and went to the United States (originally on an OSS mission) in 1944. Between 1951 and 1964 he was on the faculty of the Polytechnic Institute of Brooklyn, serving as Director of the Aerospace Institute and Head of the Department of Aerospace Engineering and Applied Mechanics.

Professor Ferri held many consultancies, and was a member of a wide variety of official committees concerned with geophysical phenomena, aeronautical propulsion and similar subjects. He was a member of many learned societies and has some 200 technical publications to his credit. He was the author of the well-known authoritative work on high-speed aerodynamics *Elements of Aerodynamics of Supersonic Flows*, and a number of other works including AGARDograph No.41, *Fundamental Data Obtained from Shock Tube Experiments*. He was the recipient of many awards including the Premio dell'Academia d'Italia (1938), the Scientific Achievement Award (1954), the Akroyd Stuard Prize of the London Royal Aeronautical Society (1965), the USAF Award Commendation for Meritorious Civilian Service (1966) and the Outstanding Achievement Award from the Office of Aerospace Research, Department of the Air Force (1970).

The AGARD community extends its sympathy to Professor Ferri's family. He will be sadly missed by his colleagues in AGARD.

LE MÉDECIN GÉNÉRAL INSPECTEUR ALBERT P.GIBERT

C'est avec une profonde tristesse que nous avons appris que le Médecin Général Inspecteur Albert P.GIBERT, Directeur de l'Ecole de Spécialisation du Service de Santé pour l'Armée de l'Air, (ESSSAA) et du Centre de Recherches de Médecine Aéronautique (CERMA), Paris, est décédé subitement le 19 Décembre 1975 à l'âge de 59 ans.

Né à Gruissan (Aude), il fit ses études à l'Université de Lyon (France), obtint le diplôme de cette université en 1942 et son diplôme de Docteur en Médecine en 1943. Titulaire du Certificat de Physiologie (1943), Otorhinolaryngologie (1957) et de Neurophysiologie (1959), il a accumulé plus de 30 ans de recherche et de pratique dans la Médecine Aéronautique.

Le Général Gibert rejoignit l'Armée Française en 1938 et fut transferré dans l'Armée de l'Air en 1946. Il servit comme Médecin et Médecin Navigant et tint de nombreux postes importants. Il fut Chef du Laboratoire Central de Biologie Aéronautique, Directeur de l'Ecole d'Application de la Médecine Aéronautique et Directeur du Centre d'Expertise du Personnel Navigant. Il a été Directeur de l'E.S.S.S.A.A. et du CERMA en 1971 et fut promu au grade de Médecin Général le 1er Juillet 1971 et de Médecin Général Inspecteur le 1er Octobre 1975.

Le Général Gibert fut nommé Professeur associé pour la Physiologie appliquée en 1960 et Professeur titulaire de la chaire de Physiologie Aéronautique Appliquée du Service de Santé des Forces Armées Françaises en 1966.

Titulaire de nombreuses décorations importantes, il était Officier de la Légion d'Honneur et membre de nombreuses sociétés savantes.

Le Général Gibert a été membre actif du Groupe de Travail ASMP d'AGARD/OTAN depuis 1970. C'était un travailleur acharné, passionné pour son métier. A côté de nombreuses activités, il présidait le Groupe de Travail d'ASMP sur "Le Mécanisme des Lésions de la Colonne Vertébrale". Il guida le développement de notre Groupe de Travail pour qu'il devienne un Organisme Consultatif efficace et c'est grâce à ses efforts que nous avons réussi à accomplir beaucoup de nos études à caractère opérationnel.

Nous adressons nos très sincères condoléances et notre sympathie à Madame Gibert et à ses enfants, ainsi qu'au Médecin Général Inspecteur de l'Armée de l'Air, le Général Inspecteur Salvagniac.

Le Général Gibert laissera un vide dans la famille de la Médecine Aérospatiale de l'OTAN et restera longtemps dans la mémoire de ses amis.

NEW AGARD TELEPHONE NUMBER IN MAY 1976

Due to a reorganization of the French telephone system, the AGARD telephone number will change in May 1976. The new number will be:

745.08.10

The date of the change will be notified later. The AGARD Telex number remains unchanged; it is:

610176 (Answer-Back AGARD 610176F)

AIRCRAFT FIRE SAFETY

by

Ingénieur en Chef J.C.Ripoll
Centre d'Essais des Propulseurs, Saclay, 91406,Orsay, France

In the Spring of 1975, among the crowd of pilgrims visiting Rome on the occasion of the Holy Year there were approximately a hundred persons activated by a more material and more disturbing concern. The participants in the 45th Symposium organized by the AGARD Propulsion and Energetics Panel were indeed delighted to be under the clear skies of this beautiful city. Thanks to the excellent organization achieved by their hosts of the Ministry of Aviation, they could enjoy its charms and its attractive sights, as well as the memories it calls up, such as the fire over which Nero sang.

In all times, means of transportation have been the source of fatal accidents and fire was always the most dangerous enemy. In antiquity fire also played a prominent part in combat between warships. Those wooden vessels, caulked with resin, undoubtedly offered very poor resistance to fire.

The existence of modern aircraft depends on strong, light-weight materials. Light-weight metals (such as aluminium or titanium) can produce violent oxidation reactions; however, the way in which they are used for construction purposes eliminates this hazard. More recently, the advent of fibre reinforced plastic materials has permitted outstanding achievements. Thanks to these materials, the passenger enjoys a high degree of comfort and can completely forget that he is flying at high altitude and speed. However, daily life activities carried out under such conditions involve hazards. Lighters, matches, cigarettes, hot plates, water heaters, lighting appliances and electric devices are potential sources of fire which can be easily fostered, in some places, even by waste paper.

For this reason, one of the recommendations expressed during the meeting dealt with the information and training for both flying personnel and passengers, who are embarked in the same venture. Compliance with orders and regulations, constant attention, knowledge of counter-measures and rapidity of action are essential factors to reduce the extent of inevitable incidents.

On the other hand, the technological qualities of materials used for the internal fittings of aircraft are offset by penalties which are revealed in case of fire. Of course, regulations restrict their construction to only those materials which are approved after specific tests. Attention is first directed towards inflammability. However, the harmful nature of the gases emitted during the decomposition of these materials by intense heat – an item which was given special consideration in the course of the meeting – represents a hazard which is all the more preoccupying as it is difficult to demonstrate and quantify. Besides, there may be some correlation between flammability and toxicity, in that toxicity may increase as flammability is decreased.

Therefore, the specialists at the meeting recommended that regulations be drawn up for the conduct of appropriately defined tests in order to obtain realistic measures of the behaviour of materials under operational conditions. The evaluation of toxicity will require refined, fast and not too costly methods of gas analysis, as well as experiments under simulated conditions on representative animals.

Although this critical question of cabin materials is predominantly of civilian interest, it did not overshadow the problems which concern all aircraft.

The statements made in 1971, at a previous meeting on the same subject, regarding the behaviour of the various types of fuels and the efficiency of some additives limiting natural spraying, were confirmed. However, this is an intrinsic difficulty which will last as long as air breathing engines. The participants implicitly agreed that it was not yet necessary to be concerned with the behaviour of new fuels such as liquified gases. Fuel spilt on the ground during aircraft accidents can be touched off by sources of ignition, amongst which the engines are the most critical. Greater emphasis must be placed on inhibiting such sources at the moment of impact.

As a matter of fact, it has been demonstrated by recent events that modern aircraft offer good structural resistance during forced landings, even in the case of loss of control. For instance, in one accident due to a missed approach by night and in the rain there is a good illustration of this fact. It was actually the subsequent fire which was responsible for the loss, and if the aircraft had been equipped with active internal means of fire fighting this fire (or, better still, with means of prevention), the results could have been quite different. This also applies to cargo compartment fires (luggage or goods) which cannot be fought by the aircrew for lack of identification by a warning network and lack of access and built-in extinguishing systems. Several papers were devoted to the qualities of extinguishing agents such as "halons", on which promising devices with a variable degree of automation could be based.

Considerable emphasis was placed on the necessity for rapid action in the presence of an incipient fire. Therefore, the aircrew must have warning devices and

fire fighting means available, and above all, be very well trained to counter fires with all methods, even in the midst of smoke which is the main inhibiting factor. In fact, the history of accidents reveals that only the aircrew can be relied on to meet the very severe challenge of combatting in-flight fires. Even on the ground, in spite of advances in means of rescue and of the eventual recourse to quasi-automatic rockets, a fast evacuation of the aircraft rests on the unwounded aircrew (which raises the problem of providing seats offering special protection for such personnel).

Training must be based on all acquired experience, and we reach here a crucial point which was strongly emphasized by all participants. It is indispensable that all incidents, even those which seem to be of minor importance, be thoroughly investigated, and that the data obtained be fully analyzed and brought to the attention of all aircrews and users. This is the only way to deal with real problems, those which an intensive consideration of the data show as very likely to occur or which have escaped the imagination of engineers at the design stage.

This is also a question of humanitarian concern and cooperation which should be clearly apparent within the framework of aeronautics and NATO, thanks to AGARD. The Working Group set up by the Propulsion and Energetics Panel at the general request of the participants at the Rome Meeting, in order to continue efforts in the field of aircraft fire safety, will count among its major objectives this cooperation and this exchange of information, including in particular the coordination of the various nations' programs.

AGARD MEETING ON SCIENTIFIC AND TECHNICAL INFORMATION TRANSFER

The following article by Dr J.H.Schulman, the Scientific Director of the United States Office of Naval Research Branch Office in London (ONRL) appeared in the 30 November 1975 issue of ONRL Scientific Notes. *It is reprinted with the author's kind permission, as it raises some controversial points which may be of general interest to scientists and engineers in the AGARD Community. The papers given at the Conference will be published shortly in AGARD Conference Proceedings No.179.*

Reflecting the worldwide interest in the methods of transferring technically useful information from those who generate or possess it to those who need and could benefit from it, the Technical Information Panel of AGARD/NATO sponsored a Specialists' Meeting on "The Problem of Optimization of User Benefit in Scientific and Technological Information Transfer" in Copenhagen on 8-9 October 1975. With relatively few exceptions (of whom the writer was one) the participants were specialists in documentation, information sciences ("Informatik"), library science, and in the operation of technical information centers.

A revealing point made in several papers was the relatively low efficacy of the formal literature in transfering innovation-producing information to industrial organizations. According to John Martyn (Head of R&D, ASLIB, London) an explanation of the secondary role of formal library systems compared to informal person-to-person communication may well be that people find conversation itself to be a creative process -- the actual operation of talking to someone else helps our own thought processes in a way that reading does not. In this connection, Martyn mentioned an intriguing experiment carried out by his organization wherein people were given tape recorders in which they were asked to keep verbal diaries of their research activities. After the initial period of stage-fright and self-consciousness wore off, the users evidently began to treat the tape recorders as surrogate colleagues with whom they were discussing their work, with a consequent unexpected benefit to their own research productivity. According to Martyn, neither management nor highly creative individuals seem to attach much importance to "information services." Yet, in his opinion, the major contribution of the entrepreneur is to link novel ideas with the market, for studies have shown that most industrial innovations are based on information brought into the firm from the outside. It would seem, therefore, that present management attitudes towards receiving information require considerable change.

The theme of the importance of direct personal communication was further developed in a paper by Prof. Thomas J.Allen (Sloan School of Management, MIT). Allen could not attend and his paper was given by Arnold Herzog (Georgetown Univ., Washington, D.C.). According to Allen, technologists don't read very much, so that literature is not very effective in bringing new ideas into an organization. Furthermore, he states, the average technologist can't communicate with outsiders by personal contact. (Egad, what a lout our typical technologist seems to be!). So how does information get into the organization from outside -- for even the best company cannot produce internally all the information it needs? According to Allen, the importers and internal disseminators of knowledge are a minority of people in the company whom he calls the "technological gatekeepers." These are a relatively small number of people who *do* read and who *can* communicate on a personal level, both inside and outside of their organizations. To the others in their companies they represent a trusted, non-threatening source of filtered and evaluated person-to-person information. The "gatekeepers" form a colle-

gial network amongst themselves, so that appropriate information thereby flows between different companies/institutions and is disseminated within each company as needed. The "gatekeepers" may occupy a variety of positions in their own organizations, but they all seem to be easily accessible to each other, and everyone in the organization can reach one or more of them.

"Technological gatekeepers," according to Allen, exist on an international level as well as on the company/institutional level. How does one best produce international gatekeepers? According to Allen, *education* in a foreign country is not particularly effective, but *employment* in a foreign country -- either on a sabbatical, fellowship, or a normal job -- *is* an effective strategy.

This experimental fact also points the way to improved methods of dissemination of information within an organization. The same processes that create international personal acquaintanceship and trust can be made to operate within a single company or institution; even a small number of interdepartmental projects and interdepartmental transfers of people can produce an impressive increase in the number of intra-company communication paths. Thus, there is the possibility of managing personal contact among scientists in a reasonably simple way. Recognizing this, Allen said, one might well decrease some of the present overemphasis on documentation as a means of information and technology transfer and put more effort into the person-to-person mechanism.

Echoes of this idea -- that information specialists have become overly preoccupied with the mechanics of their information systems and have gone too far in making them overly sophisticated -- came from two librarians, Eva Pedersen (Danish AEC, Roskilde) and Margaret O.Sheppard (State College of Victoria, Hawthorn, Australia, formerly Senior Librarian of the Aeronautical Research Laboratories (ARL), Melbourne). Pedersen acknowledged that scientists must have access to on-line data bases, but pointed out that a survey of the users of her library system showed that the human element was more important than computerized services. Sheppard recounted her experiences at the ARL, where a relatively unsophisticated service for the selective dissemination of information has been highly successful. In the ARL system the user can compile and amend his "interest profile" with minimum involvement of the librarian or information scientist.

Harold E.Pryor (Scientific and Technical Information Office (STIO), NASA, Washington, DC) agreed with the need to consult with the user. He described several questionnaire and interview techniques which the STIO employs to take the pulse of its incredible number of clients -- stated to have numbered over 1,000,000 individual users (equivalent to one out of every 200 men, women and children in the US!) at the height of the space program in the late 1960's and estimated to be still in excess of 250,000 (more than 20 times the scientific and engineering population of NASA Headquarters plus all its field Centers). Pryor discussed the various modifications that user-response has caused in the NASA publications "STAR" (Scientific and Technical Aerospace Reports) and IAA (International Aerospace Abstracts), and indicated how users are being educated to use the NASA literature search system.

The mandate to undertake dissemination of the technology used in space research was part of the Space Act of 1958, which created NASA. The Technology Utilization Division of NASA was formed as one consequence, and the New England Research Application Center (NERAC) was established at the University of Connecticut in 1966 as part of this program. Daniel Wilde recounted the strategy used by NERAC to maximize user benefit. In brief, it amounts to operating on a flat annual fee basis per customer and persuading the customer to keep plying the Center with questions (albeit one at a time!). The idea is that the pay-off to the customer is statistical -- the more questions he asks the more likely he is to hit the jackpot, which will then return more than his subscription costs in profits or savings and convince him that subscription to the service is worthwhile.

K.Klintøe (Danish Technological Information Service, Copenhagen) proposed that companies form reading groups of six to eight technical leaders under the guidance of an Information Officer to provide a systematic intake and evaluation of outside information -- in effect an organized "technological gatekeeper" system. W.Diers (Brown Boveri Co., Manneim) described steps taken in his company to overcome the indifference or passivity of potential in-house clients by getting management to let the company's Information and Documentation Center know when new R&D projects were approved. Pertinent information could then be gathered early in the R&D process and offered to the engineers in advance. Despite this step, which gave the I&D Center status and a head start, Diers admitted that the attitudes of different working groups were extremely (and inexplicably) divergent -- some welcomed the information people with open arms while others had absolutely no use for them.

Perhaps the most provocative personality at the meeting was Eric de Grolier (Prof. of Information Services at University of Tours and Consultant to the International Social Science Council of UNESCO, Paris). His paper "On the Use of Quantitative Data in Information Science" took much of present-day "information science" to task for its erroneous conclusions based on the acceptance and extrapolation of unreliable data (he was particularly critical of Derek de Solla Price's exponential growth model); for the absence of conceptual frameworks or theories that could be tested by good data; for information centers' neglect of critical reviews ("because they are too difficult to automatize") while these centers spend tremendous amounts of money for "huge accumulations of computerized bibliographic data on redundant and obsolete documents"; for the absence of good investigative techniques (he said he could demolish the validity of any of the currently accepted methods); for the lack of valid practical applications of most studies of scientific and technical information; for the lack of recognition of fairs and exhibitions as vehicles for information transfer; and for the restricted "Anglo Saxon" view of "information" as scientific and technical information only, rather than information on the humanities as well. Despite all these signs of omission and commission de Grolier was not ready to write the field off -- to the contrary, he described a few simple but good information science investigations and expressed optimism that more of the same might yet rescue the field.

SUMMARY OF 1976 MEETING THEMES

AEROSPACE MEDICAL PANEL

Specialists Meetings – **The Pathophysiology of High Sustained +Gz Acceleration, Limitation to Air Combat Manoeuvering and the Use of Centrifuges in Performance Training – Recent Experience/Advances in Aviation Pathology – Visual Aids and Eye Protection for the Aviator**
5–9 April 1976, "Domus Technica", Copenhagen, Denmark

The Pathophysiology of High Sustained +Gz Acceleration, Limitation to Air Combat Manoeuvering and the use of Centrifuges in Performance Training – Modern air superiority fighters provide a capability for very high maneuvering accelerations lasting for sustained periods. Simulator and flight tests show the tactical advantages associated with this new capability. Alternative methods for protecting aircrew exposed to high accleration have been developed. This Session will deal with potential problems and solutions relating to the following areas:

1. Acute pathophysiology associated with single exposures to high level long duration +Gz forces and potential chronic pathophysiologic changes produced by repeated exposure of aircrew to such high force environments over tours of duty in high performance aircraft.
2. Performance capabilities and limitations of aircrew in high acceleration environments, including assessment of the performance advantages of alternative methods of acceleration protection.
3. The utility of human centrifuges to train aircrew in performance of protective straining maneuvers and to train for high acceleration aerial combat engagements.

Recent Experience/Advances in Aviation Pathology – Despite sophisticated aeromedical selection procedures and a high degree of medical care during their careers aircrews continue to be involved in accidents and incidents following which pathology is revealed which had hitherto been undetected. With the increasing use of jumbo-type aircraft in both civil and military aviation the numbers of victims and/or injured aircrew/passengers continue to rise.

The pilot's performance is the key to flight safety, but the role of disease in effecting subtle psychophysiological changes in performance is not always evident or properly evaluated. It must be assumed that since relatively few autopsies are performed by aviation-trained pathologists, significant pathology is being overlooked or, when identified, is not properly being related to accident causation. Improvement is needed in human factors investigation of accidents, with greater participation by aviation qualified pathologists, and better correlation of findings with psychophysiological changes and performance degradation.

Papers will cover all appropriate aspects of recent experience and advances in aviation pathology, including the following:

1. Organization and functions of aviation pathology institutes, laboratories etc., in NATO flying forces.
2. Illness or pathophysiological conditions in aircrew as causative factors of flying incidents or accidents.
3. Sudden death in flight.
4. Toxicological aspects of flying accidents (including drugs, medication, alcohol and toxic gases).
5. Interrelation of aviation pathology and flight safety.
6. Safety, security and legal aspects of flying accident investigations.

Visual Aids and Eye Protection for the Aviator – Most of the information necessary to accomplish the flying task is gathered by the visual sense. Aviators are selected with good visual capabilities and these should be maintained at peak efficiency. A thorough eye examination and visual standards screen out most ocular pathology and visual problems felt to be incompatible with flying. However, the refractive status of the eye may change as one matures. Presbyopia, with its onset at around age 40, is inevitable. Acquired infections, trauma, genetic and environmental factors all take their toll on the visual apparatus.

Papers will deal with the aviator's eye protection against sunlight and high intensity artificial lighting, as well as under the specific conditions of flight prevailing at low altitude or above the sea, snow or even in space. Visual aids for the enhancement of distant and near vision will also be considered:

1. Helmets (shape, nature, transmission).

2. Glasses (shape, nature and transmission), taking ametropia corrections into account.

3. Contact lenses, taking into account the various prostheses now available (glasses resting on the sclera, hard lenses, soft lenses).

4. Protection against atomic flash (retinal burns and dazzling) or against the intense electromagnetic radiation found in the space environment.

33rd Panel Meeting – Specialists Meetings – **Auditory and Visual Presentation of Cockpit Information including Special Devices used for Particular Conditions of Flying – Special Aspects of Aviation Occupational and Environmental Medicine – Recent Advances in Aerospace Medicine**
20–24 September 1976, National Research Institute, Athens, Greece

(a) **Auditory Presentation of Cockpit Information**

The presentation of cockpit information requires the maximum and efficient use of all sensory modalities, and it has been appreciated recently that auditory information has received insufficient attention either on its own or when integrated into the general presentation of cockpit information. It tends to be inadequate both in its presentation, and its significance to the pilot. Current research is concerned with the display of auditory information, and in devices which may assist in its presentation and appreciation, and this session is intended to bring together such studies.

Verbal Communication. The main problem is speech intelligibility in a stressful, active and high noise environment. Speech perception, effects of high noise and high workload on speech intelligibility, and optimum levels of intelligibility for effective military communication involving both ground and airborne personnel, as well as technical problems, such as bandwidth and gain, will be considered.

Response of the Auditory System. The optimum level of signals is important to ensure that the auditory system responds in the most efficient way and avoids acute overload or long term damage.

Coded Auditory Displays. These are of special importance for effective operation. They include nav/attack displays and warning systems. The area of warning systems is particularly important and involves coded versus verbal input, specific information (e.g. fire) versus the general operation of the aircraft (e.g. approach and landing aids).

Special Devices. The use of anti-noise devices, helmet attenuation of noise, and techniques for the use of voice operated switching devices in conjunction with automatic signal gain control systems should be considered, as well as special purpose transducers.

(b) **Visual Presentation of Cockpit Information**

Visual information for flying personnel depends essentially on the data displayed on the instrument panel. Therefore, visual efficiency should be improved through: a sensible lay-out of the various instruments; the standardization of letter and figure size on dials; the most suitable location of light signals (alert, alarm, etc.); a lighting system constantly adapted to the various flight conditions (white or red light, etc.). In some cases, it is necessary to add special devices to conventional instruments, mainly: in high altitude flights where the natural lighting of the cockpit is modified; in high speed low altitude flights ("head up" display); for operational flights (tracking and firing radars); for carrier aircraft (deck landing device). The visual performance of flying personnel must also be investigated and determined.

Special Aspects of Aviation Occupational and Environmental Medicine – The aviation environment is of growing concern in respect to occupational health hazards facing not only aircrew but air traffic controllers, radar operators and ground support personnel. Populations living near airports are increasingly affected by noise and atmospheric pollution while problems associated with propellants and other chemicals, exotic diseases etc. remain in part unsolved.

The psychological stresses associated with long and hazardous missions, with high intensity air traffic control and with the disruption of the vocational, educational and other pursuits of populations living near airports are occupational and environmental health problems of concern to all aviation doctors. Information exchange is required on the conservation of health, prevention of accidents and maintenance of operational readiness. The following subjects will be covered: medical, psychiatric and psychological problems of air traffic controllers and radar operators; atmospheric, including noise, pollution by aircraft operations; industrial hazards (toxicology and pathology of propellants, and other chemicals, etc.; liquid oxygen); hygiene, sanitary regulations, exotic diseases; missile operations.

Recent Advances in Space Medicine – The Panel has studied the time and effort that should be given to space medicine. The relevance of space medicine will continue to grow in the coming decades. Many areas of space medicine include problems yet to be solved. Medical and psychological studies should pay as much attention

to the pilot and other crew members as to scientific experts aboard. This latter group will no doubt require standards and methods of selection, support, surveillance, training quite different from the former group, as well as different psychological profiles, different visual and balance requirements, different criteria of mental fitness, different procedures for indoctrinations and training, etc. The meeting will deal with such of these topics as selection of astronaut-scientists, prevention of deconditioning in weightlessness, prevention of space sickness, training to work under weightless conditions.

AVIONICS PANEL

Specialists' Meeting – **Avionic Cooling and Power Supplies for Advanced Aircraft**
10–11 June 1976, The Hague, Netherlands

The continuing increase in the quantity of avionics equipment in modern military aircraft in recent years has begun to give rise to a critical situation in terms of cooling requirements. At high speed and low level the use of the airframe or fuel as a heat sink is becoming increasingly difficult and alternative solutions must be found. These will include the reduction in the quantity of avionics and more efficient use of primary power, more efficient cooling and heat distribution, the use of components with increased temperature tolerance, and the reduction of critical components and copper conductors. This meeting will allow an identification of the problems and possible solutions and serve to alert systems and airframe designers and advise on the current state of knowledge.

31st Panel Meeting – Symposium on **New Devices, Techniques and Systems in Radar**
14–18 June 1976, The Hague, Netherlands

This meeting will fully review the various factors contributing to progress in the development of new radar systems. Coverage will be given to the availability of new devices offering greater reliability, lower cost and reduced space/weight demands. These include solid state microwave oscillators and amplifiers, low power compact travelling wave tubes, low noise crossed field amplifiers, surface acoustic wave devices and charge coupled devices. New techniques such as digital signal processing, frequency agility and electronic counter-counter measures will also be dealt with. Sessions will be devoted to advances made in the understanding of radar fundamentals, such as target and clutter characteristics, and to the simulation and modelling of radar systems. In addition new systems such as laser radars, millimeter wave radars, will be discussed, and the effects on overall radar systems of new concepts in individual parts of the system such as antennas, displays, signal processors, will be examined.

32nd Panel Meeting AVP
23rd Panel Meeting GCP – Symposium on **Avionics and Guidance and Control for RPV's**
(Joint AVP/GCP, Classified)
4–8 October 1976, Florence, Italy

There is a growing military interest in the Remotely Piloted Vehicle (RPV) to augment or replace the manned aircraft. In some typical applications the RPV might serve as a sensor to perform the roles of the forward air controller, spotter, forward observer or the reconnaissance patrol. Other sensor applications might be to extend the capabilities of radar, electro-optical or acoustic systems. The RPV might also provide an attractive alternative to the use of strike aircraft or standoff weapon delivery or as a platform for countermeasures operations. The challenge of the avionics designer is then to develop truly effective sensor systems for unmanned operation with minimized data transmission requirements and a maximum of autonomous capability. The corollary needs for effective on-board processing, jam resistant data command links, navigation and control are apparent. These objectives must be accomplished within the framework of overall systems constraints and hence place great emphasis on lightweight, low cost integrated system implementations.

It is therefore opportune to examine the state of the art in the fields of avionics and guidance and control related to RPV's. Topics covered will include sensors, communications, data processing and display, counter and counter counter measures, and guidance and control techniques particularly in relation to survivability, vulnerability, weapon delivery and other requirements, and also to launch/recovery systems.

ELECTROMAGNETIC WAVE PROPAGATION PANEL

Specialists' Meeting – **Artificial Modification of Propagation Media** (one session classified)
26–30 April 1976, Brussels, Belgium

This Specialists' Meeting will examine the topic of artificial modification of propagation media. Communication systems are affected by characteristics of different propagation media depending on frequency range and distance to be covered. The reliability of signal transmission is connected to the fluctuations of medium characteristics which may, in extreme cases, result in a complete failure of a communication link. Under certain conditions, the artificial modification of the propagation media concerned may represent a possible remedy. Such modification usually aims at an improvement of transmission reliability and signal quality, but could also cause an intentional reduction of signal intensity in certain directions and frequency ranges. The methods differ for the various media of interest, as, for instance, artificial heating for certain ionosphere regions, initiation of precipitation with consequential effects upon scattering and absorption in the troposphere, as well as distribution of reflecting scattering man-made elements in all atmospheric regions and also in space.

The Meeting will be particularly concerned with recognition and definition of limiting propagation criteria, optimum methods of modification and efficiency of changing propagation media as a function of means employed. For the possible varieties of medium modification, engineering methods as well as their present state and future development are to be discussed.

23rd Panel Meeting – Specialists' Meetings on **Electromagnetic Propagation Characteristics of Surface Materials, and Interface Aspects** and **Propagation Limitations in Navigation and Positioning Systems**
18–22 October 1976, Istanbul, Turkey

The first of these Specialists' Meetings arises from the fact that knowledge of electromagnetic surface characteristics has become of paramount importance in a number of modern fields of research and engineering applications, such as remote sensing, surveillance, target recognition etc. As a consequence of this, progress is being made with regard to certain aspects of the field such as the variability of surface parameters, their geographical distribution, and the range of their validity in the description of surface characteristics. This meeting will address all aspects of the subject including reflectivity and scattering capability, material transparency and penetration depth and in addition will highlight the engineering facets of the topic.

The second Specialists' Meeting will review the requirements placed on current and future navigation and positioning systems for sea air and ground applications, and highlight the various limitations that the propagation medium places on the operational accuracy of such systems, and the various propagation problems encountered. Methods for mitigating these problems will be fully covered, and it is hoped that the meeting will aid scientists and engineers in the planning of future navigation and positioning systems.

FLIGHT MECHANICS PANEL

48th Panel Meeting – Symposium on **Aircraft Operational Experience and its Impact on Safety and Survivability** (Classified)
31 May – 4 June 1976, Sandefjord, Norway

Aircraft operational experience provides many lessons of significance to flight mechanics specialists in the design process which consider the safety and survivability of new aircraft. In this symposium there will be 5 sessions dealing with accident statistics and analyses, design practices for a/c safety, vulnerability and survivability, operational procedures and experiences, and aircrew considerations. There will finally be a unifying discussion period. Both fixed- and rotary-wing aircraft will be dealt with.

In the first session there will be papers dealing with accident statistics and analyses, of both civil and military aircraft, which show the current major problem areas and critical flight regimes. There will also be papers dealing with post accident reconstruction and simulation and the balance between pilot error and design error as the causes of accidents. Session two, on safety design practices, will address failure analysis and the safety aspects of control system design, fire prevention systems, and system protection measures; particular emphasis will be placed on safety design for take-off and landing. Crash survivability, on-board bomb survivability, and emergency handling qualities will be addressed in session three.

The fourth session will be devoted to the experience and procedures associated with safety management, approach and landing, terrain following, extreme manoeuvre prevention and collision avoidance. Attention will be paid to the effects of meteorological phenomena. In the last session, on aircrew considerations and human factors, papers will cover an aeromedical overview, rescue systems, and workload. The symposium will end with a round-table discussion which will address the future needs of research and development in the fields of safety and survivability from a flight mechanics standpoint as indicated by operational experience.

49th Panel Meeting – Symposium on **Flight Test Techniques**
11–15 October 1976, DFVLR, Porz Wahn, FRG

This symposium will cover developments in, and improved technology for flight test techniques of CTOL aircraft including the related subjects of instrumentation and data processing. Three technology sessions and a final round-table discussion are planned.

The first session on Weapon System Clearance will address stability testing, flutter testing, loads testing, and the ground and flight testing of flight control systems. In addition, engine-inlet matching will be covered and some aspects of weapons testing will be included. The second session, on Weapon System Development and Evaluation Flight Testing, will stress aircraft performance, handling qualities, weapons delivery, and the operation and performance of major subsystems. All weather operational testing under climatic extremes will be considered. The session on Data Acquisition and Handling Techniques will concentrate on advanced state-of-the-art of instrumentation systems, including data processing and airborne displays required for safe and efficient flight tests. Specific topics will be: unique or advanced sensors including airborne flight test displays; airborne signal conditioning and processing; and ground based and satellite based data relay and recovery systems. Papers will discuss how real-time, on-line, data processing is used to provide displays and permit decision making which can affect test control. In conclusion the round table discussion will pinpoint the major areas requiring further work in the light of the future needs of flight testing.

FLUID DYNAMICS PANEL

38th Panel Meeting – Symposium on **Application of Non-Intrusive Instrumentation in Fluid Flow Research**
3–7 May 1976, Saint-Louis, France

The symposium will focus on recent advances and developments in the application of non-intrusive instrumentation in fluid mechanics. There is a continuing pressing requirement in fluid flow research for high quality accurate data, which is often difficult to obtain with conventional probe type measuring systems which can locally disturb the flow and adversely affect the measurements. Instrumentation techniques applicable to compressible turbulent flows will form the major part of the program, but special capabilities in low speed flows or under special flow conditions will also be discussed.

Specific areas of interest include the accuracy, spatial resolution, band-width (frequency response), signal-to-noise ratio, special operational problems and signal processing and data handling necessary to derive the flow field parameters (velocity, density, temperature).

Immediately following the symposium, a laser anemometry workshop is planned. The workshop, organized and planned by ISL with assistance by AGARD, will provide a laboratory demonstration of laser operation thus enabling each participant to select the system which, from an economic and capability point of view, best suits his needs. Alternatives and advances in the various types of lasers, indicators, detectors, and data processing techniques will be identified in detail.

39th Panel Meeting – Specialists Meeting on **Numerical Methods and Windtunnel Testing**
23–24 June 1976, VKI Brussels, Belgium

This specialists' meeting is being held to mark the 20th anniversary of the VKI. The role of the computer in fluid mechanics research will be discussed and evaluated, emphasizing those cases where the computer system is selected and matched with the particular windtunnel capabilities. Total integration of the windtunnel and the computer to allow efficient complementary operation will be discussed and specific examples given. Those fluid dyanamic computer programs under development as well as those successfully in operation will be identified and evaluated.

40th Panel Meeting – Symposium on **Prediction of Aerodynamic Loading**
27 September – 1 October 1976, Moffett Field, California, USA

The drive towards better effectiveness/cost entails closer matching between the airframe and the aerodynamic loads that arise on it – both in respect to pressure distributions and the numbers of load repetitions. Meanwhile, aircraft are increasingly being required to operate in conditions that were previously unfamiliar (for example far into heavy buffeting, into manoeuvre departures, with mixed transonic and separated flow). Such trends increase the importance of reliable methods for predicting the number and distribution of significant loads, which will be the theme of this symposium.

The symposium will be concerned particularly with the fluid motion aspects of predicting aerodynamic loads on aircraft and their external stores, and especially those loads that may be troublesome. Specific areas of interest include transient or fluctuating loads where the load depends on the rate of entry into a manoeuvre, such as entry into gusts or turbulence, and rapid manoeuvres into post buffet conditions or dynamic stall. Additionally, substantial fluctuations of local pressure may lead to cracking of panels or control circuit components caused by unsteady boundary-layer separation, vortices passing close to a surface, or proximity of a jet efflux. Information will be exchanged in these areas and directions for future research will be identified.

GUIDANCE AND CONTROL PANEL

22nd Panel Meeting – Symposium on **Night and All-Weather Guidance and Control Systems for Fixed-Wing Aircraft** (Classified)
3–7 May 1976, United Kingdom

For many years, aircraft operating at night have used radar and radio systems to provide guidance and control information regarding the terrain above which they operate. More recently, however, a range of electro-optical and other sensors have become available, capable of providing high definition pictures of the ground in non-visual conditions. To take full advantage of the opportunities presented, many new problems must be solved, since these sensors can in no way be viewed as a simple replacement for the human eye. The use of these devices as an aid to piloting close to the ground, and for the location of targets and other ground features, is of particular interest. It is the purpose of this symposium to expose and discuss these problems, to arrive at an evaluation of the latest state-of-the-art and to chart the path for the future so that the capabilities of the NATO air forces may be enhanced at the earliest possible date.

This technical activity will complement the 1974 meeting devoted to the "The Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility". It has been divided into five major areas: requirements and experience – piloting and navigation – target acquisition – system design – overall system optimization and integration.

23rd Panel Meeting – Joint Symposium (with Avionics Panel) on **Avionics/Guidance and Control for Remotely Piloted Vehicles** (Classified)
4–8 October 1976, Florence, Italy

There is growing military interest in the Remotely Piloted Vehicle (RPV) to augment or replace the manned aircraft in such applications as performing the role of the forward air controller, spotter, forward observer or the reconnaissance patrol and extending the capabilities of radar, electro-optical or acoustic systems. The RPV might also provide an attractive alternative to the use of strike aircraft or stand-off weapon delivery or as a platform for countermeasures operations.

As for the guidance and control aspects, the potential subjects to be presented during the symposium might include:

- the operational concepts and requirements and their influence on RPV guidance and control,
- RPV guidance and flight control techniques,
- survivability/vulnerability and their impact on RPV guidance and control systems,
- target acquisition, and weapons delivery and their impact/interaction with RPV guidance and control,
- RPV command and control,
- launch guidance and recovery guidance for RPV's.

PROPULSION AND ENERGETICS PANEL

47th Panel Meeting – Specialists Meetings on **Small Solid Propellant Rockets for Field Use** (Classified) and **Through Flow Calculations in Axial Turbomachinery**
17–21 May 1976, Porz-Wahn, Germany

The first of the two-day Specialists Meetings will be on the subject of small solid propellant rockets for field use and will be classified. It will primarily be concerned with noise and shock problems of shoulder-launched weapons. Technology to reduce noise and shock effects while improving range and accuracy through increased muzzle velocity and techniques to decrease projectile weight and increase propellant energy will be reviewed. Problems involved with handling, burn-rate sensitivity and maneuverability will also be discussed.

The second meeting will deal with sophisticated computational procedures for calculation of flow fields in turbomachines which have been made possible by the advent of high-speed computers. The development of new measuring techniques including optical methods allows improved comparison between theory and the actual flow field in cascades and rotating components. The new techniques in this field will allow a fruitful exchange of ideas and comparison of techniques.

48th Panel Meeting – Symposium on **Variable Geometry and Multi-Cycle Aero Engines**
6–10 September 1976, Paris, France

While variable exhaust nozzles and compressor stators are in wide use today they have been used primarily to avoid problems and constraints, not to improve capabilities. Significant enhancement of performance is possible in aircraft where equal amounts of fuel are consumed in both subsonic and supersonic flight, in VTOL aircraft with severe throttle variations, and in very high speed aircraft to meet take-off and landing requirements. The planned approach is to asses the state-of-the-art and provide preliminary examinations of what could be achieved with variable geometry, as well as defining what technology is needed. The primary objective is to determine what can be achieved with propulsion systems having more than one "design point".

STRUCTURES AND MATERIALS PANEL

42nd Panel Meeting – Specialists Meetings on (a) **Advanced Fabrication Techniques in Powder Metallurgy and Their Economic Implications** and (b) **Helicopter Design Mission Load Spectra**
4–9 April 1976, Government Conference Centre, Ottawa, Canada

(a) Advanced powder metallurgy manufacturing techniques are becoming an attractive method for producing high performance aircraft components. Their economic implications are of comparable importance. This Specialists Meeting will concentrate on Titanium and Nickel alloys for parts mainly used in jet engines, but structural applications are also included. Authors and discussors will try to answer such questions as:

1. What are major advantages and disadvantages of powder metallurgy techniques as applied to aerospace materials?
2. Are the major incentives towards using powder metallurgy methods technological or economic?
3. In which areas and applications is it anticipated that powder metallurgy will make the greatest impact?
4. Are the prospects good for an essentially one-step consolidation process from powder to near-finished shape part, or will further mechanical deformation always be necessary?
5. Which are the critical areas that impose the greatest limitations to advancement?

(b) As mission requirements cause the utilization to vary over the life of any helicopter fleet, the problem of predicting the structural life of helicopter components becomes more complex. If the component lives cannot be accurately predicted, they will fail prematurely and require costly replacements, maintenance and inspection costs will increase, and the operational availability of the helicopters will decrease. A prime cause of the inability to accurately predict component lives is the lack of adequate mission load spectra, which is compounded by increasingly more sophisticated mission requirements and the consequent greater complexity in component loading. Realistic helicopter design criteria, based upon a truer representation of actual operational conditions, will minimize the over or under design of critical components, reduce either the initial costs or the subsequent maintenance and inspection costs, improve the service operation of the helicopter fleet, and reduce the life cycle cost of the entire fleet. The Specialists Meeting will address

the requirements for mission load spectra and the current work being conducted within the various NATO countries.

43rd Panel Meeting – Specialists Meetings on (a) **Fracture Mechanics Design Methodology** and (b) **Acoustic Fatigue Review**
26 September – 1 October 1976, Church House, London, United Kingdom

(a) The intent of the Specialists Meeting on Fracture Mechanics Design Methodology will be to explore the increasing need for techniques for avoiding the deleterious effects of flaws and their propagation during service operation. Current approaches to material characterization, such as COD, R curve and J integral will be considered with regard to representative aerospace structures, new methods will be studied and standard techniques will be sought for the application of this information to practical fracture control.

(b) When it concluded its efforts in October 1973, the Panel's Working Group on Acoustic Fatigue observed that there would be continued interest in this field in the future. It was at that time recommended that new facets of this subject be explored by a future meeeting of specialists. It was proposed to hold this meeting when the Acoustic Fatigue Data Sheets, prepared under the AGARD cooperative project on Acoustic Fatigue and published in three parts as AGARDograph 162, had received exposure and had been in actual use in the various member nations for a reasonable period. Accordingly, this Specialists Meeting will be comprised of short papers reviewing current and recent work on Acoustic Fatigue in each country, presenting ideas for new work and giving an assessment of the data sheets published by AGARD.

TECHNICAL INFORMATION PANEL

29th Panel Meeting – Specialists' Meeting on **Advancements in Retrieval Technology as Related to Information Systems**
20–22 October 1976, Washington, DC, USA

The ultimate test of any information system is whether or not the user can quickly, easily and comprehensively obtain relevant information stored therein. As data bases expand and networking increases the number of bases available to the user, retrieval technology must advance if the user is to be able to benefit fully from this increased information potential.

The subject has breadth and flexibility, and is particularly suitable for a meeting in the United States where the value of the meeting can be enhanced by arranging for a number of interesting demonstrations utilizing the highly advanced technology of the United States hardware and software industry. Among subjects that will be covered are terminal technology, communication techniques, main frame technology, mass storage technology, software concepts, indexing and classification, data base sharing and small-scale retrieval systems.

LECTURE SERIES

Lecture Series 80 – **Aerodynamic Noise** (with the von Kármán Institute and the Fluid Dynamics Panel)
6–9 December 1976, von Kármán Institute, Belgium

Lecture Series 80 is intended to provide an up-to-date account and authoritative appraisal of aerodynamic noise concepts, theory and experiments; with particular reference to practical methods for the prediction, measurement and reduction of external noise from jet/fan aircraft. Following an overview of relevant aircraft design and operational considerations, the main lectures will include detailed presentations on the fundamental theory of aerodynamic noise generation and propagation, basic aero-acoustics of jet efflux, engine exhaust noise characteristics, fan noise, airframe self-noise, airframe/engine interaction effects, experimental techniques for aerodynamic noise research, and aircraft fly-over noise measurement. A round table discussion in which all the speakers will participate, will be organized at the end of the fourth day.

The Lecture Series Director is: Professor J.Williams, Aerodynamics Department, Royal Aircraft Establishment, Farnborough, UK.

Lecture Series 81 – **Avionics Design for Reliability** (with the Avionics Panel)
5– 6 April 1976, Munich, Germany
8– 9 April 1976, London, UK
13–14 April 1976, Rome (N.Y.), USA

The programme covered by Lecture Series 81 addresses and discusses problems of avionic unreliability. Typical methods for forcing reliability into new design and development, and into new procurement requirements will be described. Typical life cycle costs as affected by the reliability achieved will be included. The case for improving initial designs with more background experience, greater patience and thoroughness by the designer will be viewed as perhaps the soundest and in the long run the most economical means for reliability attainment. Case histories involving both reliability testing and field reliability achievement will be described. Of special interest will be the opportunity to review problems and recommendations from a multi-national viewpoint.

As in previous Lecture Series, the last item on the programme will be a panel discussion which will give the audience an almost unlimited opportunity further to explore areas of special interest with any of the speakers.

The Lecture Series Director is: Dr E.Keonjian, Greenvale, New-York, USA.

Lecture Series 82 – **Practical Aspects of Kalman Filtering Implementation** (with the Guidance and Control Panel)
10–11 May 1976, Bolkesjø, Norway
13–14 May 1976, Delft, The Netherlands
17–18 May 1976, Rome, Italy

The Lecture Series will concentrate on practical experience gained from development of filters and hardware. Examples will be given on experiences gained in the development of inertial navigation systems for aircraft (C5A–F 111) for ship tracking system as well as various applications, details on filter design and implementation of the B1 mechanisation will also be provided.

The implementation problems involved in ground-based calibration and alignments will be covered, together with the development of a standard covariance analysis programme for a variety of terrestrial navigators.

The Lecture Series Director is: Dr George T.Schmidt, The Charles Stark Draper Laboratory, Cambridge, Massachusetts, USA.

Lecture Series 83 – **Modern Prediction Methods of Turbomachine Performance** (with the Propulsion and Energetics Panel)
11 June 1976, Paris, France (Round Table)
14–15 June 1976, Munich, Germany
17–18 June 1976, London, UK

Propulsion system development costs may be significantly reduced by improvement of methods for prediction of compressor and turbine component performance, and by preliminary study of the interactive operation of compressors and turbines with other system components. After the build-up of development engines, it is necessary to understand and carefully plan the process of rematching of components for optimum system performance.

This Lecture Series will include lectures and a panel discussion on the historical background of turbomachine performance prediction, on current procedures for estimation of overall and blade row performance characteristics, and on qualitative and quantitative turbomachine performance information needed for evaluation of the effects of compressor and turbine behavior on the complete propulsion system. The lectures on component performance prediction will cover both current and developing technology for axial-flow compressors and turbines, centrifugal compressors and radial-inflow turbines.

Lecture Series 84 – **Prevention and Combat of Corrosion in Aircraft Structures** (with the Structures and Materials Panel)
6– 7 October 1976, Dayton (Ohio), USA
11–12 October 1976, Delft, The Netherlands
14–15 October 1976, Lisbon, Portugal

The corrosion problem needs to be brought forcefully and vividly to the attention of engineers of all disciplines and in all fields of endeavour. Probably the most important single perspective that needs emphasizing is that there is an overwhelming need for education of materials engineers on corrosion. A substantial portion of government and industrial funds for corrosion should be allocated for well conceived educative ventures.

The return on this investment should be great. Virtually all premature corrosion failures these days occur for reasons which were already well-known, and these failures can be prevented. Unfortunately, many design engineers and other engineers are woefully ignorant of corrosion and its ramifications and do not consider the corrosion aspects as they should. As a result, many unexpected and costly failures occur.

The technical programme will be as follows. After an introductory lecture to survey the corrosion problem, corrosion theory will be presented. Corrosion in airframes, power plants, electronics and equipment is reviewed and prevention techniques will be discussed. Case histories will be presented before a panel dialogue with the audience.

The Lecture Series Director is: Mr Nathan E.Promisel, Former Chairman, SMP, Silver Spring, Maryland, USA.

Lecture Series 85 – **Review of Developments in Computer Output Microfilm (COM) and Micrographic Technology, Present and Future** (with the Technical Information Panel)
25–26 October 1976, Lysebu, Norway
28–29 October 1976, Paris, France
1– 2 November 1976, London UK

This lecture will start with the presentation of an up-to-date on micrographic technology, Computer Input Microfilm (CIM), and Computer Output Microfilm (COM), as well as an indication of the market size and growth rate. After micrographic fundamentals, the COM recording techniques and recorders will be presented and the techniques used in CIM will be reviewed. Other lectures will cover indexing and retrieval techniques, systems design, alphanumeric and graphic applications. Future trends for micrographic technology will terminate the presentation, which will be followed by a final round table discussion.

The Lecture Series Director is: Mr D.M.Avedon, Technical Director, National Micrographics Association, Colesville Road, Silver Spring, Maryland, USA.

MILITARY COMMITTEE STUDIES

11th Meeting of the **Aerospace Applications Studies Committee**
17–27 May 1976, London, UK

The Committee will receive the final report on Study No.9 on "Advanced Technology to Counter Low Altitude Threats", conducted a mid-term review of Study No.10 on "Communications Devices Supporting Air Warfare with Reduced Susceptibility to Jamming, Intercept, and Location Determination", and organize a new Working Group for Study No.11 on "Suppression of Detection and Guidance Systems, Other than Radar, Associated with SAMs, ASMs and Guided Bombs".

12th Meeting of the **Aerospace Applications Studies Committee**
8–18 November, Paris, France

The Committee will receive the final report on Study No.10, conduct a mid-term review of Study No.11, define terms of reference for Studies No.12 and No.13 in response to direction received from the September 1976 Meeting of the AGARD National Delegates Board, and organize a new Working Group for Study No.12.

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